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Environmental Assessment

Cooper Creek Watershed Project

Blue Ridge Ranger District, Chattahoochee-Oconee National Forests
Union County, Georgia

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SUMMARY

The Chattahoochee-Oconee National Forests proposes the following elements: a) Vegetation Management (commercial timber harvest, prescribed burning, stand improvement, site preparation, and reforestation treatments); b) Road Access (System Road reconstruction, temporary road construction, seasonal and year-round closures and changes to road maintenance levels). The project area is located in the Cooper Creek watershed (HUC# 060200030102) and the adjacent Coosa Creek (HUC# 060200020505) and Youngcane Creek (HUC# 060200020506) watersheds, in Union County Georgia and is within the Blue Ridge Ranger District, Chattahoochee-Oconee National Forests, Georgia. This action is needed, because many of the stands in the project area are dense and overcrowded, with limited understory or ground cover diversity.

In addition to the proposed action, the Forest Service also evaluated 2 other alternatives (No Action alternative and Alternative 3).

Based upon the effects of the alternatives, the responsible official will decide whether the proposed action will proceed as proposed, as modified, or not at all, and if it does proceed, decide what mitigation measures and monitoring requirements will be applied to the proposed action.

CHAPTER 1: PURPOSE AND NEED

1.1 Document Structure

The Forest Service has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into six parts:

- ***Chapter 1 – Purpose and Need:*** The section includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- ***Chapter 2: Comparison of Alternatives, including the Proposed Action:*** This section provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes possible mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- ***Chapter 3: Affected Environment and Environmental Consequences:*** This section describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource. Within each section, the affected environment is described first, followed by the effects of the No Action Alternative and proposed action alternatives. The No-Action alternative provides a baseline for evaluation and comparison of the other alternatives that follow.
- ***References Cited:*** This section lists all of the references consulted in the writing of this report.
- ***Agencies and Persons Consulted:*** This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- ***Appendices:*** The appendices provide more detailed information to support the analyses presented in the environmental assessment.

1.1.1 Planning Record

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Blue Ridge Ranger District Office in Blairsville, GA. It contains planning records, field notes, and maps.

1.2 Background

The project is located in the Cooper Creek watershed (HUC# 060200030102) and the adjacent Coosa Creek (HUC# 060200020505) and Youngcane Creek (HUC# 060200020506) watersheds, in Union County Georgia (Figure 1.2.1).

The purpose and need for action was informed by the Cooper Creek Watershed Assessment (completed in 2011), the Watershed Restoration Action Plan (WRAP) for the Cooper Creek Watershed (completed in 2011), the Cooper Creek Ecological Classification System (ECS) (completed in 2013) and the Chattahoochee-Oconee National Forests Land and Resource Management Plan (Forest Plan). The watershed assessment described Current Condition, Desired Future Condition, and Possible Management Practices/Opportunities for each resource area. In addition, related Forest Plan Goals and Objectives and Inventory Needs also were identified. The Cooper Creek WRAP identified specific actions that could be taken to improve conditions in the watershed. The Cooper Creek ECS system was

developed through a spatial analysis of landscape variables to produce a map of potential vegetation for the area. The ECS was used to identify actions needed to move the area toward desired conditions and to match objectives identified in the watershed assessment to the most ecologically appropriate portions of the project area. (McNab et al. 2015)

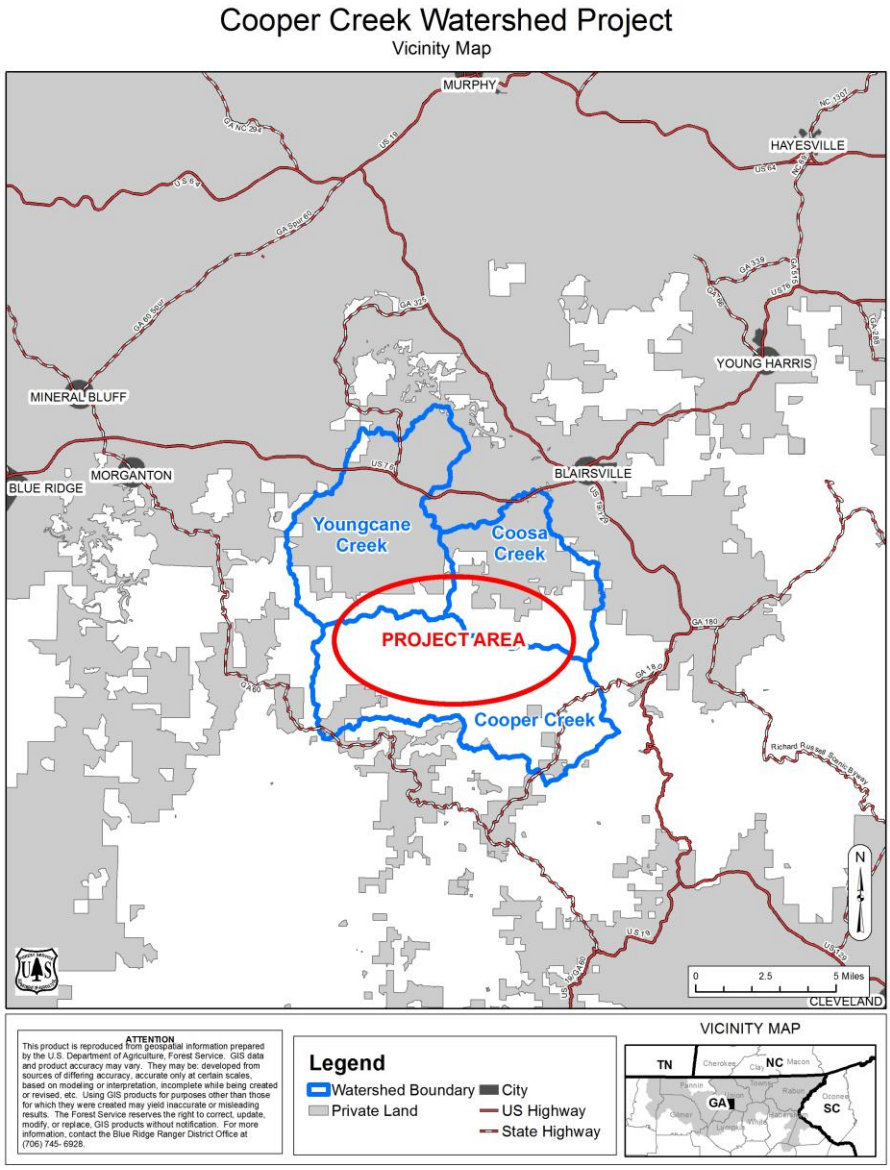

Figure 1.2.1. Cooper Creek Watershed Project.

1.3 Purpose and Need for Action

The purpose of the Cooper Creek Watershed project is to restore native plant communities, enhance wildlife habitat conditions, and improve forest health. This action is needed, because many of the stands in the project area are dense and overcrowded, with limited understory or ground cover diversity. Due to limited use of prescribed fire over the last few decades, advanced oak regeneration is limited

and white pine has encroached into many of the hardwood stands and now comprises a substantial portion of the understory and midstory. This action responds to the goals and objectives outlined in the Forest Plan for the Chattahoochee-Oconee National Forests, and helps move the project area towards desired conditions described in that plan (USDA Forest Service 2004a).

1.4 Proposed Action

The action proposed by the Forest Service to meet the purpose and need includes the following elements:

(1) Vegetation Management (commercial timber harvest, prescribed burning, stand improvement, site preparation, and reforestation treatments);

(2) Road Access (System Road reconstruction, temporary road construction, seasonal and year-round closures and changes to road maintenance levels).

The proposed action was developed at the onset of the project and is based on site-specific needs and preliminary issues. It was used during the scoping process and was provided to individuals, groups and organizations to review and identify additional issues. The proposed action is described in detail in Chapter 2 (Section 2.2.2).

1.5 Forest Plan Direction

The Land and Resource Management Plan for the Chattahoochee-Oconee (USDA Forest Service, 2004a) sets forth management direction for managing the land and resources of the Chattahoochee-Oconee National Forests, and among other things, describes management goals and objectives, resource protection methods, and desired resource conditions. The Land and Resource Management Plan is the result of programmatic analysis, which is addressed in the Forest Plan FEIS (USDA Forest Service, 2004b).

The Cooper Creek Watershed Project Environmental Assessment is a project-level analysis; its scope is confined to addressing the relevant issues and possible environmental consequences of the project. Where appropriate, the Cooper Creek Watershed Restoration Project environmental analysis will tier to the Forest Plan FEIS, as encouraged by 40 CFR 1502.20.

Management Area and Management Prescriptions

A portion of the area is in the Cooper Creek Wildlife Management Area which is cooperatively managed by the Georgia Department of Natural Resources. The majority of the proposed activities will occur in Management Prescriptions 7.E.1 –Dispersed Recreation Areas, 7.E.2- Dispersed Recreation Areas with Vegetation Management, and 9.H- Management, Maintenance, and Restoration of Plant Associations to their Ecological Potential. Portions of the proposed prescribed burns also will occur in Management Prescriptions 3.A – Coosa Bald National Scenic Area, 4.F.2 Regional Forester Designated Scenic Areas, and 4.H Forest-Designated Outstandingly Remarkable Streams. The Cooper Creek Watershed has been identified as a priority watershed on the Chattahoochee-Oconee National Forests because of its important ecological values, resource related concerns that needed to be addressed, and strong partnership opportunities.

The project will address a number of Forest Plan Goals and Objectives including:

GOAL 2: A diversity of habitat will be provided for the full range of native and other desired species. Sufficient amounts of interior or late-successional habitat as well as early-successional habitat will be

provided to meet needs of all successional communities. Early successional habitat will be well distributed in all forest types, elevations, aspects, and slopes including riparian corridors

GOAL 3: Enhance, restore, manage and create habitats as required for wildlife and plant communities, including disturbance-dependent forest types.

OBJECTIVE 3.1: Within the first 10 years of Plan implementation restore 1,100 acres of shortleaf pine forests on the Chattahoochee on sites where they once likely occurred.

OBJECTIVE 3.4: Within the first 10 years of Plan implementation restore 10,000 acres of open woodlands, savannas, and grasslands on the Chattahoochee. Once created, maintain woodlands, savannas, and grasslands on a five-year burning cycle or less.

OBJECTIVE 3.6: Within the first 10 years of Plan implementation restore oak or oak-pine forests on 1,250 acres on the Chattahoochee on appropriate sites currently occupied by pine plantations or other hardwood species such as gum and maple.

OBJECTIVE 3.7: To maintain existing oak and oak-pine forests, reduce stem density on 5,500 acres on the Chattahoochee of these forest types within the first 10 years of Plan implementation.

OBJECTIVE 3.8: Create and maintain an annual average of 300 acres above 3,000 feet elevation in early-successional habitats, achieving 3,000 acres within the first 10 years of Plan implementation. This acreage may be comprised of regenerating forests (0-10 years), utility rights-of-way, and open woodlands.

GOAL 4: Maintain and restore natural communities in amounts, arrangements, and conditions capable of supporting viable populations of existing native and desired nonnative plants, fish, and wildlife species within the planning area.

GOAL 7: Manage forest ecosystems to maintain or restore composition, structure, and function within desired ranges of variability.

OBJECTIVE 7.1: Within 10 years of Plan implementation, increase structural diversity by creating canopy gaps within closed-canopied mid- and late-successional mesic deciduous forest, including old growth restoration areas.

- 10,800 acres on the Chattahoochee

GOAL 8: Contribute to maintenance or restoration of native tree species whose role in forest ecosystems: (a) has been reduced by past land use; or (b) is threatened by insects and disease, fire exclusion, forest succession, or other factors.

OBJECTIVE 8.1: To maintain shortleaf pine forests on the Chattahoochee in desired conditions:

- Thin over-story trees on an average of 400 acres per year of this forest type.
- Reduce hardwood mid-story on an average of 6,000 acres per year of this forest type.

GOAL 9: Manage through protection, maintenance, or restoration, a variety of large, medium, and small old growth patches to provide biological and social benefits.

GOAL 49: Close and restore unneeded roads and motorized trails.

OBJECTIVE 49.1: Over the first 15 years of Plan implementation close at least 50 percent of open roads and/or motorized vehicle trails unneeded for public access or to accomplish long-term forest management objectives.

GOAL 61: Expand the role of fire to recover and sustain short interval fire-adapted ecosystems through the use of both prescribed and managed ignition fires, including allowing lightning-caused fire to function, as much as possible, as a natural process; especially in Wilderness or other custodial management areas.

1.6 Incorporation by Reference and Use of Science

Some material in this document tiers to or incorporates by reference related information in order to reduce the size and degree of redundancy in this document. Documents tiered to and materials incorporated by reference include the following:

- Material specifically cited or otherwise used in preparation of this document is hereby incorporated by reference.
- Information in this document tiers to the Forest Plan and FEIS.

The techniques and methodologies used in this analysis consider current and accurate science. The analysis includes a summary of the credible scientific evidence which is relevant to evaluating reasonably foreseeable impacts. The analysis also identifies methods used and references scientific sources relied on. When appropriate, the conclusions are based on the scientific analysis that shows a thorough review of relevant scientific information, a consideration of responsible opposing views, and the acknowledgment of incomplete or unavailable information. Literature reviewed and considered by specialists in the analyses is listed in References Section and in the respective technical reports (in the project record).

1.7 Decision Framework

In consideration of the stated purpose and need and this analysis of environmental effects, the Blue Ridge District Ranger, Chattahoochee-Oconee National Forests, as the Responsible Official, will decide whether the proposed action will proceed as proposed, as modified, or not at all, and if it does proceed, decide what mitigation measures and monitoring requirements will be applied to the proposed action.

1.8 Public Involvement

Existing conditions and Forest Service recommendations regarding resource management in the Cooper Creek watershed were documented in the Cooper Creek Watershed Assessment Report (Appendix B). A stakeholder meeting to discuss the findings of the watershed assessment, as well as to gather public input on the potential management activities, was held at the Georgia Mountain Research and Education Center in Blairsville, GA on August 9, 2011. A stakeholder meeting to present the findings of the Cooper Creek Ecological Classification System (ECS) was held in the field on October 14, 2012.

The proposal was provided to the public and other agencies listed on the Blue Ridge District mailing list for comment during scoping on May 2, 2014. This document described the proposed actions, preliminary issues identified by an interdisciplinary team, who to contact for additional information, and how and where to send comments. The proposal was listed in the Schedule of Proposed Actions on July 1, 2014. Five hundred and eighty-nine responses were received during the scoping period. Each comment was analyzed, categorized, and summarized through use of the Content Analysis and Response

Application (CARA). Using the comments from the public, other agencies, and from within, the interdisciplinary team developed a list of issues to address.

1.9 Issues

The Interdisciplinary Team (IDT) identified driving issues to be addressed in the environmental analysis (EA) based on comments received from the public, other agencies and from within. These issues guide the formulation of alternatives and provide a framework for the effects analysis to be documented in the environmental analysis.

The purpose of soliciting comments during the scoping period is to determine whether there are any relevant issues based on the proposed action. An issue is generally a point of discussion considered in determining the final unresolved concerns.

Issues are relevant because of the extent of their geographic distribution, the duration of their effects, or the intensity of interest or resource conflict. Once identified, the relevant issues are used to formulate alternatives, prescribe mitigation measures, or analyze the environmental effects. Identified relevant issues determine the scope (40 CFR 1508.25) of the environmental analysis. Relevant issues identified through the scoping process include:

Issue: Cutting of Mature Oaks

Issue Statement: The cutting of mature oaks will affect the availability of acorns for wildlife.

Background: Acorns produces by oak trees are an important source of food for a variety of wildlife species. The proposed action includes 168 acres of natural regeneration of oak dominated stands. These sites will develop into young oak stands that, along with other proposed activities including thinning of overstocked oak stands, midstory treatments to enhance oak regeneration, release of existing oak regeneration, and prescribed burning, will provide for continued availability of oaks into the future.

Comments were submitted that expressed concerns over the effects of the cutting of mature oaks on the availability of acorns for wildlife and expressed a desire to retain all mature oaks. The effects of the proposed action and alternatives on the quantity of mature oaks and the availability of acorns are discussed in Chapter 3 of this document.

Issue: Appropriateness of Woodlands

Issue Statement: Concerned about the appropriateness of sites proposed for woodlands as well as the sustainability of woodland due to the need for herbicide application and frequent burning.

Background: The proposed action includes the restoration of woodland conditions on 766 acres using both commercial timber harvest and non-commercial treatments in conjunction with prescribed burning. Woodlands are one of the dominant Forest Plan restoration goals for the Chattahoochee National Forest. Sites proposed for woodland restoration in the Cooper Creek Project were identified through the use of the Cooper Creek Ecological Classification System.

Comments were submitted that expressed concerns that (1) prior to European settlement, very little woodland existed on the forest, and only in less productive areas determined by specific geology and soils; and certainly none in the area of the Cooper Creek Watershed Project (2) to be truly restorative, proposed woodland restoration activities must be evaluated based on an individual site's specific characteristics (e.g., soils, geology, slope, aspect, moisture regime, and potential productivity based in part on present vegetation and on Forest Service site index); (3) the fact that these woodlands, once created, could not be self-sustaining, instead requiring frequent prescribed burning every 3-5 years in order to maintain an open condition suggests that these sites are inappropriate for woodlands.

The effects of the proposed action and alternatives on the availability of woodland habitat as well as the appropriateness of the sites selected for woodland restoration are discussed in Chapter 3 of this document.

Issue: Quantity and Location of Early Successional Forest Habitat

Issue Statement: Concerned about the location and quantity of early successional forest habitat (ESFH) in the existing proposal.

Background: Early successional forest habitat is extremely limited in the Cooper Creek watershed, comprising less than 0.5% of project area. The proposed action includes 253 acres of regeneration harvest to create early successional forest habitat. The Forest Plan provides objectives for levels of early successional forest habitat and as well as standards dictating the maximum percentage of early successional forest habitat for each Management Prescription. For the Cooper Creek Project, maximum levels range 4 to 10 % of the forested acres depending on the Management Prescription.

Comments were submitted that expressed concerns that (1) the quantity of ESFH proposed is inadequate and additional acres of ESFH should be created to the maximum extent permitted in the Forest Plan; (2) ESFH should be well distributed throughout all forest types, elevations and topographies within the Project area, including riparian corridors, which create a particularly rich habitat type; (3) Selection of treatment stands for developing ESFH should focus on midslope transition zones between uplands and lower slopes as well as riparian fringes; (4) ESFH should be created by cutting down existing 30-40 year old clearcut stands. The effects of the proposed action and alternatives on the quantity and location of early successional forest habitat is discussed in Chapter 3 of this document.

Issue: Impacts on Old Growth

Issue Statement: Concerned about the impacts of the proposed action on old growth forests.

Background: Old growth provides both biological and social values. Old growth and other mature communities provide large den trees for wildlife species such as black bear, large snags for birds, bats and cavity nesters, and large cover logs for other wildlife. Old-growth areas provide for certain recreational experiences, research opportunities, and educational study. The Forest Plan provides direction in the protection of existing old-growth and the designation of small, medium, and large potential old-growth blocks.

Comments were submitted that expressed concerns that (1) logging existing old-growth forest undermines a unique characteristic of the Forest that support biodiversity, protect the soil, protect water quality, provide natural recreation areas, and above all, supports and protects the many species of birds and other wildlife that require these types of forest resources in order to survive and thrive; (2) proper, thorough field surveys for old growth should be done, and all existing growth should be protected. The effects of the proposed action and alternatives on old growth are discussed in Chapter 3 of this document.

Issue: Use of Herbicides

Issue Statement: The use of herbicides will adversely affect the environment and they should not be used on this project.

Background: The proposed action includes the targeted use of herbicides to enhance oak regeneration and the development of herbaceous understories by controlling competing species such as red maple, yellow polar, and white pine.

Comments were submitted that expressed concerns over the effects of herbicides on non-target plants, fauna, and water quality. The effects of herbicides on the environment are discussed in Chapter 3 and in the detailed Risk Assessment (Appendix F) of this document.

Issue: Project Scale

Issue Statement: The scale of the project is inappropriate.

Background: The proposed action included 2,315 acres of commercial harvest, 1,679 acres on non-commercial treatments, and 11,842 acres of prescribed burning.

Comments were submitted that expressed concerns that the proposed project was both too large and not large enough. The impacts of project scale were addressed by developing an additional alternative and are discussed in Chapter 3.

CHAPTER 2: ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 Introduction

This chapter describes and compares the alternatives considered for the Cooper Creek Watershed Project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

2.2 Alternatives Considered in Detail

2.2.1 Alternative 1: No Action

The "No action" alternative is included to meet requirements of the National Environmental Policy Act [40 CFR 1502.14 (d)] which stipulates that "in addition to the proposed action, the no action alternative shall always be fully developed and analyzed in detail." Under this alternative, none of the activities described in under Alternative 2 (The Proposed Action) would occur in the project area, except for previously approved dormant season prescribed burns.

2.2.2 Alternative 2: The Proposed Action

The proposed action includes the following elements:

(1) Vegetation Management (commercial timber harvest, prescribed burning, stand improvement, site preparation, and reforestation treatments);

(2) Road Access (System Road reconstruction, temporary road construction, seasonal and year-round closures and changes to road maintenance levels).

(1)Vegetation Management:

Oak/Oak-Pine Thinning (Goal 3, Obj. 3.7):

The Blue Ridge Ranger District is proposing to commercially reduce the basal area (BA) in overstocked, oak-dominated stands. The purpose of the treatment is to encourage oak regeneration and improve the health and vigor of these stands. Additional benefits, such as increased herbaceous understory, may also be achieved. Residual BA may vary with each stand, but will range from 60 -80 square feet per acre. One of the objectives is to restore and sustain the more desirable white and red oak species, therefore those species will be high priority for retention. Most of these stands are on north facing aspects that are dominated by chestnut oak with declining white and northern red oak populations.

The treatment may be accomplished using ground based equipment and undesirable species such as yellow poplar and red maple may require herbicide treatments to reduce sprouting.

Compartment	Stand	Forest Type	Age	Acres
398	10	Chestnut oak	108	18
398	23	Chestnut oak	117	32
398	37	Chestnut oak, Northern red oak	111	13
399	20	Chestnut oak, Scarlet oak, White pine	99	20
505	7	Chestnut oak, White oak	110	29
			Total	**112**

Pine/Pine-Oak Thinning (White Pine Removal) (Goal 3, Obj. 3.6):

The stands proposed for pine thinning are high density white pine dominated stands of varying ages. The proposal is to reduce the basal area (BA) of these stands by focusing on commercial white pine thinning using ground based equipment. Other undesirable species such as yellow poplar and red maple may be removed and may require herbicide treatment to prevent stump sprouts. These treatments will improve the health and vigor of the stands and will release desirable oak species, thus restoring oak to its native sites. In those stands where sufficient oak regeneration is not present, thinning will allow sunlight to reach the forest floor stimulating oak regeneration over time. Residual BA for thinning may vary with each stand but will range from 60-80 square feet per acre.

Compartment	Stand	Forest Type	Age	Acres
398	7	White pine	88	55
398	33	White pine, Virginia pine	88	22
399	12	White pine, Chestnut oak, Northern red oak	81	38
399	14	White pine, White oak, Northern red oak	88	21
399	21	White pine	30	30
399	49	White pine	31	21
399	59	White pine, White oak, Chestnut oak	94	12
503	32	White pine, White oak, Chestnut oak	89	32
504	10	White pine	53	44
504	12	White pine	109	86
504	16	White pine	89	65
504	17	White pine, Red maple, Chestnut oak	119	43
504	28	White pine, Hemlock	89	95
504	30	White pine	89	29
504	50	White pine, Chestnut oak, Scarlet oak	54	12
505	11	White pine, White oak, Yellow poplar	41	20
505	12	White pine, White oak, Scarlet oak, Chestnut oak	110	68
505	23	White pine, Hemlock, White oak	100	17
505	25	White pine, White oak, Chestnut oak	106	36
505	26	White pine	30	21
505	27	White pine, White oak, Chestnut oak	30	11
505	29	White pine	98	25
505	30	White pine	98	19
505	31	White pine	100	21
			Total	**843**

Canopy Gap Thinning (Goal 7, Obj. 7.1):

Canopy gap thins have many definitions, but for our purposes they may be defined as a stand level reduction in basal area (BA) combined with small openings of 0.25 to 0.5 acres each. Thinning may be accomplished commercially with ground based equipment.

The primary purpose of canopy gap thinning is to increase structural diversity in mesic hardwood stands to enhance habitat for bird species. In addition, the reduction in BA will allow sunlight to reach the forest floor stimulating oak regeneration.

The stands are mostly mid-successional mature mesic hardwood stands consisting of yellow poplar, chestnut oak, white oak, northern red oak, and hickory. White pine is a minor component in a few of the stands and chestnut oak is abundant. Stands are overstocked with closed canopies. Residual basal area (BA) may vary with each stand, but will range from 60-80 square feet per acre. The dominant trees in these stands will be selected for retention and will include oaks and other soft and hard mast producing species.

Compartment	Stand	Forest Type	Age	Acres
398	6	Chestnut oak	104	8
398	8	White oak, Northern red oak, Hickory	109	37
398	12	Chestnut oak	104	27
398	16	Chestnut oak	89	16
398	17	White pine, Yellow poplar	32	25
398	19	Yellow poplar	89	18
398	24	Chestnut oak, Yellow poplar	114	86
398	25	Chestnut oak, Yellow poplar, White oak, Northern red oak	117	51
398	28	Yellow poplar, White oak, Northern red oak	108	52
399	2	Chestnut oak	108	16
399	3	Yellow poplar	78	11
399	6	Chestnut oak	99	42
399	37	Chestnut oak, Yellow poplar, White oak, Northern red oak	98	49
399	62	Chestnut oak, Yellow poplar, White oak, Northern red oak	99	28
			Total	**466**

Early Successional Forest Habitat (Goal 2):

Stands proposed for regeneration range from true cove stands consisting primarily of yellow poplar to more xeric stands dominated by oak species. The primary purpose of regenerating these stands is to improve habitat conditions for species such as ruffed grouse and other early successional species. Secondary objectives include restoration of oak on sites where white pine is dominating but not ecologically appropriate and oak maintenance in existing oak stands.

Stands will be harvested with a two-aged with reserves method, retaining approximately 20 square feet of basal area (BA) of overstory trees per acre. Stands may require post-harvest release treatments (chemical, mechanical and/or burning) to reduce competition from undesirable species. Following harvest, the white pine stands will require site preparation treatments, planting of native oak species, and subsequent release treatments. Site preparation treatments may include chemical and/or non-chemical methods such as prescribed burning.

Compartment	Stand	Forest Type	Age	Acres	Post-Harvest Cultural Treatments
398	5	Yellow poplar	104	15	NA*
398	32	White pine	32	20	Site prep, planting, release

Compartment	Stand	Forest Type	Age	Acres	Post-Harvest Cultural Treatments
399	8	Yellow poplar	88	22	NA*
399	50	Yellow poplar, Northern red oak	98	18	Release
399	54	Chestnut oak, Northern red oak, Yellow poplar	99	27	Release
504	15	White oak, White pine, Chestnut oak	120	42	Release
504	26	Northern red oak, Chestnut oak, Hickory	164	41	Release
504	31	White pine	54	28	Site prep, planting, release
505	28	Chestnut oak, Black oak, White oak	120	18	Release
505	32	Chestnut oak, Scarlet oak, Northern red oak	110	22	Release
			Total	**253**	

Remark: *NA=Not Applicable

Woodland Restoration (Goal 3, Obj. 3.4):

Woodland habitat is a type of early successional habitat that is important to a number of species of concern. The stands proposed for woodland restoration vary in age, density, and diameter range, but are all primarily oak dominated stands on south facing slopes and xeric sites. Many of these stands are above 3,000 feet in elevation making them suitable for high elevation early successional habitat as well.

The stands proposed for woodland restoration have been separated into two categories by the treatment type. The first table includes stands that are being considered for commercial thinning to achieve the woodland state, while the second table includes stands proposed for non-commercial thinning. To achieve the desired woodland condition, the density of the stands will need to be reduced to less than 60 square feet per acre of basal area (BA). However, the degree of basal area reduction will vary within these stands depending on site conditions. On the dry ridges (xeric to subxeric) within these stands, overstory basal area (BA) will be reduced to 15 to 30 square feet per acre. Below the ridges on the subxeric slopes, residual BA will range from 30 to 60 square feet per acre. The more mesic portions of these stands will not be managed as woodland but will be thinned to 60-80 BA to enhance oak regeneration and improve forest health.

Following harvest, these stands will be prescribed burned to control woody sprouting and encourage herbaceous development. Until the desired condition has been reached, burning intensity, frequency and seasonality will be guided by project-level monitoring. Species selected for retention would include fire tolerant hardwoods and yellow pines. Commercial thinning would be accomplished using ground based equipment. Post-harvest herbicide treatments may be necessary to encourage the dominance of herbaceous species, and reduce sprouting of undesirable hardwoods such as yellow poplar and red maple.

Compartment	Stand	Forest Type	Age	Acres
503	6	Chestnut oak, White oak, Scarlet oak	121	18
503	7	White pine, Chestnut oak, White oak	90	44
503	34	White oak, Scarlet oak, White pine	131	21
504	4	Chestnut oak, White oak, Scarlet oak	119	59
504	5	Chestnut oak, White oak, Black oak	109	39
504	7	Chestnut oak, White oak, Black oak	119	44

Compartment	Stand	Forest Type	Age	Acres
504	8	Chestnut oak, White oak, Scarlet oak	119	38
504	9	Chestnut oak	129	34
504	18	Chestnut oak, Northern red oak	119	58
505	3	Chestnut oak, Scarlet oak	113	12
505	4	Scarlet oak, White oak, Chestnut oak	103	29
505	6	Chestnut oak, White oak, White pine	124	30
505	9	White oak, White pine	110	36
505	15	Chestnut oak, Northern red oak, Black oak	38	18
505	21	White pine, Chestnut oak, Scarlet oak	38	38
505	22	Black oak, White pine	100	10
506	1	White pine, Chestnut oak, White oak	57	21
506	28	White pine, White oak, Chestnut oak	62	26
633	17	Chestnut oak, Scarlet oak, White oak	133	10
633	19	White oak, Scarlet oak, Northern red oak, White pine	53	12
633	24	Northern red oak, Scarlet oak, White oak	103	44
			Total	**641**

The following table includes stands proposed for non-commercial thinning. This treatment would be accomplished by cutting trees manually with a chainsaw and/or using a herbicide treatment. In both cases, woody material will be left on site.

Compartment	Stand	Forest Type	Age	Acres
503	31	Chestnut oak, Northern red oak, Yellow poplar	141	39
503	33	White oak, Northern red oak, White pine	23	22
504	1	Chestnut oak, Black oak	119	40
633	18	Chestnut oak, Scarlet oak, White oak	133	14
633	29	Chestnut oak, White oak, Red maple	53	8
			Total	**123**

Midstory Treatment (Goal 3, Obj. 3.7):

The purpose of the midstory treatment is to allow enough sunlight to the forest floor to stimulate new and existing oak regeneration while providing enough shade to suppress shade intolerant species such as yellow poplar. The desired result is oak regeneration that is at least 4.5 feet tall in preparation for stand regeneration. The majority of these oak dominated stands are on north facing aspects (Compartments 398 and 399) where yellow poplar is very competitive. The remaining stands are on south facing aspects. Stands vary in the density of the midstory, but all have little to no oak regeneration, and where present is in the seedling stage.

This treatment would be accomplished by cutting trees manually with a chainsaw and/or using a herbicide treatment. In both cases, woody material will be left on site. To prevent undesirable shade intolerant species from regenerating, the overstory canopy should be left intact, and no more than 30% of the total basal area (BA) treated. Follow up treatments may be necessary.

Compartment	Stand	Forest Type	Age	Acres
398	3	Chestnut oak, Northern red oak	117	53
398	1	Chestnut oak, White oak, Northern red oak	105	14
398	9	Yellow poplar, Chestnut oak, Northern red oak	108	21
398	11	Chestnut oak	117	19
398	29	White oak, Chestnut oak	108	12
398	34	White oak, White pine, Yellow poplar	88	11
399	1	Northern red oak, Chestnut oak	99	45
399	5	White pine	78	21
399	7	Chestnut oak, Scarlet oak, Northern red oak	98	25
399	11	Chestnut oak, Yellow poplar	98	43
399	13	White pine, Northern red oak	68	23
399	15	Chestnut oak, Northern red oak	119	26
399	16	Chestnut oak, White oak, Northern red oak	118	9
399	17	Chestnut oak, Northern red oak, Yellow poplar	98	45
399	19	Northern red oak, Chestnut oak, Yellow poplar	133	27
399	22	Northern red oak, Chestnut oak, Yellow poplar	104	21
399	23	Yellow poplar, Chestnut oak	93	15
399	27	Chestnut oak, Northern red oak, White pine	103	43
399	28	Chestnut oak	108	48
399	30	Chestnut oak, Northern red oak, Yellow poplar	99	24
399	31	Chestnut oak, White oak, Northern red oak	103	14
399	35	White oak, Chestnut oak, Northern red oak	98	59
399	36	White oak, Chestnut oak, Northern red oak	93	17
399	38	Chestnut oak, Scarlet oak, Red maple	88	23
399	45	Chestnut oak, Northern red oak	98	46
399	46	Chestnut oak, Scarlet oak, Northern red oak	98	67
399	51	Chestnut oak, Northern red oak	94	13
399	52	Chestnut oak, Scarlet oak, Yellow poplar	99	11
399	56	Chestnut oak, White pine	98	12
399	57	Chestnut oak, White oak, Northern red oak	99	15
399	58	Northern red oak, Chestnut oak	99	39
504	13	Black oak, White oak, Chestnut oak	119	23
504	20	White oak, Black oak	129	19
504	21	White pine, Chestnut oak	119	13
504	24	Chestnut oak, White pine	119	57
505	8	Chestnut oak, Scarlet oak	103	41
505	19	Chestnut oak, Scarlet oak, Yellow poplar	123	16
505	20	Black oak, White oak, Chestnut oak	107	26
			Total	**1056**

Release (Goal 3, Obj. 3.7):

The following stands were regenerated between 1970 and 1990. They were harvested by complete overstory removal without ensuring the presence of advanced oak regeneration resulting in stands dominated by yellow poplar. However, oaks are present in sufficient quantity that a crop tree release would transition the stand into a more desirable oak dominated condition.

The release would be accomplished with manual chainsaw felling and/or herbicide treatments, with woody material left on site. Only those trees competing with desirable oaks or other soft and hard mast producing species would be treated, and would most likely include red maple and yellow poplar.

Compartment	Stand	Forest Type	Age	Acres
399	18	Yellow poplar, White oak, Northern red oak	40	24
399	32	Yellow poplar, White oak, Northern red oak	31	24
399	34	Yellow poplar, White oak, Northern red oak	40	29
399	53	White pine	23	7
504	19	Yellow poplar, White oak, Northern red oak	24	41
504	23	Yellow poplar, White oak, Northern red oak	25	34
504	25	White oak, Yellow poplar, White pine	34	25
504	27	Yellow poplar, White oak, Northern red oak	33	24
504	29	Yellow poplar, White oak, Northern red oak	24	30
505	17	Yellow poplar	26	22
			Total	**260**

Herbicide Use – The Proposed Action includes the use of herbicides for connected site preparation, release and midstory control treatments in certain restoration and maintenance treatment areas. A total of 3251 acres of herbicide use is proposed. Although the majority of the treatment is proposed for upland areas, in order to protect aquatic resources, only aquatically labeled herbicides will be used.

Oak/Oak-Pine Thinning and Pine/Pine-Oak Thinning: In areas proposed for Oak/Oak-Pine and Pine/Pine-Oak thinning, undesirable species such as yellow poplar and red maple and may be treated with herbicides to control sprouting and to promote oak regeneration. Midstory vegetation would be treated using a combination of foliar and/or cut-stump methods through directed applications of triclopyr herbicides. Foliar methods would be employed to treat stump sprouting vegetation and other woody vegetation less than 6 feet in height. Cut-stump methods would be used for taller vegetation.

Early Successional Forest Habitat: 1) Site preparation: In areas proposed for oak restoration through the planting of oak seedlings, harvested areas would be site prepared for regeneration using a combination of foliar and/or cut-stump methods through directed applications of triclopyr herbicides. Treatments would be directed at non-desirable woody vegetation remaining on site following the commercial harvests - typically stump sprouting vegetation less than 6 feet tall (foliar method) or standing trees from 1 inch to 8 inches dbh (cut-stump method). 2) Release: Connected release treatments would be employed in areas proposed for regeneration to promote growth of planted or naturally regenerating oak seedlings. Planted and/or naturally regenerated oaks would be released one or more times by directly applying triclopyr herbicides to competing vegetation within a three to four foot radius of seedlings using the foliar method.

Woodland Restoration: In areas proposed for woodland restoration, both with commercial harvest and without (non-commercial), midstory vegetation may be treated with herbicides to create a more open understory environment. Midstory vegetation would be treated using a combination of foliar and/or cut-stump methods through directed applications of triclopyr herbicides. Foliar methods would be employed to treat stump sprouting vegetation and other woody vegetation less than 6 feet in height. Cut-stump methods would be used for taller vegetation.

Midstory Control: In areas proposed for mid-story vegetation control, midstory vegetation would be treated with herbicides to increase natural oak regeneration. Midstory vegetation would be treated using either injection or cut-stump methods through direct applications of triclopyr herbicides.

Release: In areas proposed for crop tree release, trees competing with desirable oaks or other soft and hard mast producing species would be treated using a either injection or cut-stump methods through direct applications of triclopyr herbicides.

Estimated herbicide rates to be applied under the proposed herbicide treatments are shown below. These rates will be the basis for the risk assessment analysis which is disclosed in Chapter 3.

Herbicide	Application Method(s)	Lbs ai/gal	% (fraction) in solution	Gallons of solution/acre	Lbs ai/acre
Triclopyr (amine)	Cut-stump	3.0	50%	1.0	1.5
Triclopyr (amine)	Injection	3.0	50%	1.0	1.5
Triclopyr (amine)	Foliar	3.0	4%	15	1.8

Prescribed Fire: These control burns would be implemented by hand and/or aerial ignition methods on a landscape scale, with the desired goal of a mosaic burn pattern. High to moderate fire intensities are desired for the south and west-facing xeric ridges, with moderate intensity fire on the midslopes. Low intensity backing fires will be used adjacent to trails and in riparian areas and mesic hardwood stands, allowing the fire to burn naturally. A site-specific burn plan would be prepared for each burn unit. This plan will describe the weather and fuel conditions under which the burn could be safely executed and consider the effects of the fire on other resources, including smoke impacts. All bladed dozer lines used to contain the burns would be re-vegetated and meet best management practices, after the burn is conducted, using a non-invasive grass mixture that is best suited to the area, time of year and benefit to wildlife. The preferred fire lines will consist of existing roads, streams, and constructed hand line while limiting and reducing the amount of bladed dozer line.

Burning would take place during both the dormant and growing season to achieve the desired fire conditions. The dormant season is defined as approximately November 1st through April 15th, with the primary implementation period being February through March. The growing season is approximately April 16th through October 30th, with the preferred time being April 16th through May. After initial treatments, a 3-5 year prescribed fire rotation is expected to be necessary to continually maintain the

desired conditions. Project level vegetation monitoring will be used to determine exactly when and how many prescribed burns are needed to maintain the fire adapted habitats within these burn units.

Prescribed Burn Block Name	Acres	Season
Addie Gap	551	Growing/Dormant
Bryant Creek	1,375	Growing/Dormant
Coosa Bald	2,143	Growing/Dormant
Duncan Ridge (3 Units)	647	Growing/Dormant
Rich Ridge	1,161	Growing/Dormant
Spencer Mtn	1,502	Growing/Dormant
Fish Knob	1,764	Growing/Dormant
Cliff Ridge	1,543	Growing/Dormant
Dunsmore Mtn	1,156	Growing/Dormant
Total	11,842	

(2) Road Access

System Road Reconstruction: This will include curve widening/realignment to accommodate timber haul activities, reshaping of the road template to restore proper drainage, and as needed, replacement of existing culverts and drainage structures to address present and future resource needs and Best Management Practices (BMP's).

Road Name	Road Number	Estimated Mileage
Mulky Gap	4	**0.2**
Spenser Mountain	4D	**0.6**
Cooper Creek	33	**0.2**
Bryant Creek	33A	**0.6**
Duncan Ridge	39	**0.7**
Burnett Creek	261	**0.3**
Gillespie Branch	287	**0.2**
Total		**2.8**

Temporary Road Construction: To provide access for the commercial vegetation management treatments, up to 5 miles of temporary roads will be constructed, the majority of which will utilize previous temporary road templates. These roads will be closed and re-vegetated after use.

Year-round and Seasonal Closures and Changes in Road Maintenance Levels: The Chattahoochee-Oconee National Forests recently completed a Travel Analysis Process (TAP) that identified a target road system needed for safe and efficient travel and access while also providing for the protection, management, and use of the National Forest. This target road system is also an effort by the agency to more closely align the current transportation network with existing program capacities. Based on this analysis and other resource considerations, a number of system roads in the Cooper Creek Watershed have been proposed for year-round and/or seasonal closure, or administrative changes in the road Maintenance Level.

Year-Round Closure: Mark Helton Branch (33B) would be closed to all vehicular traffic (both administrative and public). Duncan Ridge Branch (39B) would be closed year-round to public vehicular traffic. Both are dead-end roads that receive limited use. The closure of these roads to vehicular traffic would reduce maintenance requirements down to basic custodial care.

Road Name	Road Number	Estimated Mileage
Mark Helton Branch	33B	4.5
Duncan Ridge Branch	39B	2.2
Total		**6.7**

Seasonal Closure: The following roads or segments of these roads would be closed to public use from approximately January 1 to March 15 – the exact dates will be weather dependent. These roads would be closed during this time period of unfavorable weather where a combination of conditions and use results in the rapid deterioration of the road template, resulting in a public safety hazard as well as significant resource damage.

Road Name	Road Number	Estimated Mileage
Flatlands	637	1.5
Knight Creek	264A	2.9
Longcove Creek	264B	1.2
Gillespie Branch	287	2.0
Dixon Branch	88	3.7
Duncan Ridge (portion)	39	3.0
Bryant Creek	33A	3.3
Sea Creek	264	4.0
Total		**21.6**

Change in Road Maintenance Levels: The Road Maintenance Levels would be changed for the following roads. These roads are in the Lake Winfield Scott Recreation Area and the change more accurately reflects the current level of maintenance.

Road Name	Road Number	Mileage	Change in ML*
Lake Winfield Scott Branch C	37C	0.1	ML2 to ML 4
Lake Winfield Scott Branch D	37D	0.2	ML2 to ML 3
Total		**0.3**	

***ML2- Maintained for use by high-clearance vehicles and not suitable for passenger cars**
ML3- Maintained to be passable to prudent drivers in passenger cars during the normal season of use
ML4- Maintained to provide a moderate degree of user comfort and convenience at moderate travel speeds for prudent drivers in a standard passenger car during normal season of use

2.2.3 Alternative 3

As discussed above, the original proposed action was presented to the public in a letter dated May 2, 2014. Responses from the public were considered and additional field work and analysis were conducted. In response to the issues raised in scoping and factors such as access and operability, the acre of commercial timber harvest was reduced from 2,315 acres to 1,679 acres. In some cases stands proposed in the original proposed action were dropped completely and in other cases they were changed to a non-commercial treatment (Appendix E). The most substantial changes were decreases in the acres of commercial canopy gap treatments and woodland treatment. The acreage proposed for early successional forest habitat did not change, although the locations of many of the stands to be regenerated were shifted to include stands on the lower portions of the slopes and/or in areas outside of prescribed burning blocks. The acreage of non-commercial treatment decreased from 1,439 acres to 912 acres, primarily due to a reduction in midstory treatments. As a result of these changes, the acreage of potential herbicide use was reduced by over half from approximately 3251 acres to 1327 acres.

This alternative reflects some minor changes in the road reconstruction mileage with a shifting in priorities among the roads and an overall increase from 2.8 miles to 3 miles. The estimated mileage of temporary roads remained unchanged. This alternative includes the expansion of 2 existing parking lots.

(1)Vegetation Management:

Oak/Oak-Pine Thinning (Goal 3, Obj. 3.7):

The Blue Ridge Ranger District is proposing to commercially reduce the basal area (BA) in overstocked, oak-dominated stands. The purpose of the treatment is to encourage oak regeneration and improve the health and vigor of these stands. Additional benefits, such as increased herbaceous understory, may also be achieved. Residual BA may vary with each stand, but will range from 60 -80 square feet per acre. One of the objectives is to restore and sustain the more desirable white and red oak species, therefore those species will be high priority for retention.

Compartment	Stand	Forest Type	Age	Acres
398	37	Chestnut oak, Northern red oak	111	13
504	23	Yellow poplar, White oak, Northern red oak	25	34
505	9	White oak, White pine	110	36
505	28	Chestnut oak, Black oak, White oak	120	18
			Total	**101**

Pine/Pine-Oak Thinning (Goal 3, Obj. 3.6):

The stands proposed for pine thinning are high density white pine dominated stands of varying ages. The proposal is to reduce the basal area (BA) of these stands by focusing on commercial white pine thinning using ground based equipment. These treatments will improve the health and vigor of the stands and will release desirable oak species, thus restoring oak to its native sites. In those stands where sufficient oak regeneration is not present, thinning will allow sunlight to reach the forest floor stimulating oak regeneration over time. Residual basal area (BA) for thinning may vary with each stand but will range from 60-80 square feet per acre.

Compartment	Stand	Forest Type	Age	Acres
398	7	White pine	88	55
399	21	White pine	30	30
399	49	White pine	31	21
399	53	White pine	23	7
503	32	White pine, White oak, Chestnut oak	89	32
504	10	White pine	53	44
504	12	White pine	109	86
504	16	White pine	89	65
504	17	White pine, Red maple, Chestnut oak	119	43
504	28	White pine, Hemlock	89	95
504	30	White pine	89	29

Compartment	Stand	Forest Type	Age	Acres
504	50	White pine, Chestnut oak, Scarlet oak	54	12
505	11	White pine, White oak, Yellow poplar	41	20
505	12	White pine, White oak, Scarlet oak, Chestnut oak	110	68
505	23	White pine, Hemlock, White oak	100	17
505	25	White pine, White oak, Chestnut oak	106	36
505	26	White pine	30	4
505	27	White pine, White oak, Chestnut oak	30	11
505	29	White pine	98	25
505	30	White pine	98	19
505	31	White pine	100	21
			Total	**740**

Canopy Gap Thinning (Goal 7, Obj. 7.1):

Canopy gap thins have many definitions, but for our purposes they may be defined as a stand level reduction in basal area (BA) combined with small openings of 0.25- 0.5 acres each. Commercial thinning may be accomplished with ground based equipment.

The primary purpose of canopy gap thinning is to increase structural diversity in mesic hardwood stands to enhance habitat for a variety of bird species. In addition, the reduction in basal area (BA) will allow sunlight to reach the forest floor stimulating oak regeneration.

The stands are mostly mid-successional mature mesic hardwood stands consisting of yellow poplar, chestnut oak, white oak, northern red oak, and hickory. White pine is a minor component in a few of the stands and chestnut oak is abundant. Stands are overstocked with closed canopies. Residual basal area (BA) may vary with each stand, but will range from 60- 80 square feet per acre. The dominant trees in these stands will be selected for retention and will include oaks and other soft and hard mast producing species.

Compartment	Stand	Forest Type	Age	Acres
398	6	Chestnut oak	104	8
398	16	Chestnut oak	89	16
398	17	White pine, Yellow poplar	32	25
398	19	Yellow poplar	89	18
398	28	Yellow poplar, White oak, Northern red oak	108	33
			Total	**100**

Non-Commercial Canopy Gap Treatment (Goal 7, Obj. 7.1):

The following table includes stands proposed for non-commercial canopy gap treatment. In these stands, small canopy gaps of 0.25 to 0.5 acres will be created to increase structural diversity. No thinning will occur between the groups. This treatment would be accomplished by cutting trees manually with a chainsaw with the woody material left on site.

Compartment	Stand	Forest Type	Age	Acres

Compartment	Stand	Forest Type	Age	Acres
399	2	Chestnut oak	108	16
399	3	Yellow poplar	78	11
399	37	Chestnut oak, Yellow poplar, White oak, Northern red oak	98	49
399	62	Chestnut oak, Yellow poplar, White oak, Northern red oak	99	28
			Total	**104**

Early Successional Forest Habitat (Goal 2):

Stands proposed for regeneration range from true cove stands consisting primarily of yellow poplar to more xeric stands dominated by oak species and mixed pine. The primary purpose of regenerating these stands is to improve habitat conditions for species such as ruffed grouse and other early successional species. Secondary objectives include restoration of oak on sites where white pine is dominating but not ecologically appropriate and oak maintenance in existing oak stands.

Stands will be harvested with a two-aged with reserves method, retaining approximately 20 square feet basal area (BA) of overstory trees per acre. Stands may require post-harvest release treatments (chemical, mechanical and/or burning) to reduce competition from undesirable species. Following harvest, the white pine stands will receive site preparation treatments, planting of native oak species, and subsequent release treatments. Site preparation treatments may include chemical and/or non-chemical methods such as prescribed burning.

In addition to the stands to be regenerated, two closed wildlife opening access roads, totaling approximately 1 mile also will be daylighted to provide additional early successional forest habitat. The stands within 100 feet either side of these roads will be commercially thinned to approximately 20 square feet of basal area.

Compartment	Stand	Forest Type	Age	Acres	Post-Harvest Cultural Treatments
398	28	Yellow poplar, White oak, Northern red oak	108	19	Release
398	32	White pine	32	20	Site prep, planting, release
398	33	White pine, Virginia pine	88	22	Release
399	12	White pine, Chestnut oak, Northern red oak	81	20	Release
399	14	White pine, White oak, Northern red oak	88	20	Release
504	15	White oak, White pine, Chestnut oak	120	25	Release
504	21	White pine, Chestnut oak	119	13	Release
504	31	White pine	54	28	Release
505	7	Chestnut oak, White oak	110	29	Release
505	19	Chestnut oak, Scarlet oak, Yellow poplar	123	16	Release
505	26	White pine	30	17	Site prep, planting, release
Road Daylighting				20	Release
			Total	**249**	

Woodland Restoration (Goal 3, Obj. 3.4):

Woodland habitat is a type of early successional habitat that is important to a number of species of concern. The stands proposed for woodland restoration vary in age, density, and diameter range, but are all primarily oak dominated stands on south facing slopes and xeric sites. Many of these stands are above 3,000 feet in elevation making them suitable for high elevation early successional habitat as well.

The stands proposed for woodland restoration have been separated into two categories by the treatment type. The first table includes stands that are being considered for commercial thinning to achieve the woodland state, while the second table includes stands proposed for non-commercial thinning. To achieve the desired woodland condition, the density of the stands will need to be reduced to less than 60 square feet per acre of basal area (BA). However, the degree of basal area reduction will vary within these stands depending on site conditions. On the dry ridges (xeric to subxeric) within these stands, overstory basal area (BA) will be reduced to 15 to 30 square feet per acre. Below the ridges on the subxeric slopes, residual BA will range from 30 to 60 square feet per acre. The more mesic portions of these stands will not be managed as woodland but will be thinned to 60-80 BA to enhance oak regeneration and improve forest health.

Following harvest, these stands will be prescribed burned to control woody sprouting and encourage herbaceous development. Until the desired condition has been reached, burning intensity, frequency and seasonality will be guided by project-level monitoring. Species selected for retention would include fire tolerant hardwoods and yellow pines. Commercial thinning would be accomplished using ground based equipment. Post-harvest herbicide treatments may be necessary to encourage the dominance of herbaceous species, and reduce sprouting of undesirable hardwoods such as yellow poplar, and red maple.

Compartment	Stand	Forest Type	Age	Acres
503	6	Chestnut oak, White oak, Scarlet oak	121	18
503	7	White pine, Chestnut oak, White oak	90	44
503	34	White oak, Scarlet oak, White pine	131	21
504	4	Chestnut oak, White oak, Scarlet oak	119	59
504	5	Chestnut oak, White oak, Black oak	109	39
504	18	Chestnut oak, Northern red oak	119	58
505	3	Chestnut oak, Scarlet oak	113	12
505	4	Scarlet oak, White oak, Chestnut oak	103	29
505	6	Chestnut oak, White oak, White pine	124	30
505	15	Chestnut oak, Northern red oak, Black oak	38	18
505	21	White pine, Chestnut oak, Scarlet oak	38	38
505	22	Black oak, White pine	100	10
506	1	White pine, Chestnut oak, White oak	57	21
506	28	White pine, White oak, Chestnut oak	62	26
633	17	Chestnut oak, Scarlet oak, White oak	133	10
633	19	White oak, Scarlet oak, Northern red oak, White pine	53	12
633	24	Northern red oak, Scarlet oak, White oak	103	44
			Total	**489**

The following table includes stands proposed for non-commercial thinning. This treatment would be

accomplished by cutting trees manually with a chainsaw and/or using a herbicide treatment. In both cases, woody material will be left on site.

Compartment	Stand	Forest Type	Age	Acres
503	31	Chestnut oak, Northern red oak, Yellow poplar	141	39
503	33	White oak, Northern red oak, White pine	23	22
504	1	Chestnut oak, Black oak	119	40
504	7	Chestnut oak, White oak, Black oak	119	44
504	8	Chestnut oak, White oak, Scarlet oak	119	38
504	9	Chestnut oak	129	34
633	18	Chestnut oak, Scarlet oak, White oak	133	14
			Total	**231**

Midstory Treatment (Goal 3, Obj. 3.7):

The purpose of the midstory treatment is to allow enough sunlight to the forest floor to stimulate new and existing oak regeneration while providing enough shade to suppress shade intolerant species such as yellow poplar. The desired result is oak regeneration that is at least 4.5 feet tall in preparation for stand regeneration. The majority of these oak dominated stands are on north facing aspects (Compartments 398 and 399) where yellow poplar is very competitive. The remaining stands are on south facing aspects. Stands vary in the density of the midstory, but all have little to no oak regeneration, and where present is in the seedling stage.

This treatment would be accomplished by cutting trees manually with a chainsaw and/or using an herbicide treatment. In both cases, woody material will be left on site. To prevent undesirable shade intolerant species from regenerating, the overstory canopy should be left intact, and no more than 30% of the total basal area (BA) treated. Follow up treatments may be necessary.

Compartment	Stand	Forest Type	Age	Acres
398	1	Chestnut oak, White oak, Northern red oak	105	14
398	29	White oak, Chestnut oak	108	12
399	1	Northern red oak, Chestnut oak	99	45
399	28	Chestnut oak	108	48
399	30	Chestnut oak, Northern red oak, Yellow poplar	99	24
399	31	Chestnut oak, White oak, Northern red oak	103	14
399	35	White oak, Chestnut oak, Northern red oak	98	59
399	36	White oak, Chestnut oak, Northern red oak	93	17
504	13	Black oak, White oak, Chestnut oak	119	23
504	20	White oak, Black oak	129	19
504	24	Chestnut oak, White pine	119	57
505	20	Black oak, White oak, Chestnut oak	107	26
			Total	**358**

Release (Goal 3, Obj. 3.7):

The following stands were regenerated between 1970 and 1990. They were harvested by complete overstory removal without ensuring the presence of advanced oak regeneration resulting in stands

dominated by yellow poplar. However, oaks are present in sufficient quantity that a crop tree release would transition the stand into a more desirable oak dominated condition.

The release would be accomplished with manual chainsaw felling with woody material left on site. Only those trees competing with desirable oaks or other soft and hard mast producing species would be treated, and would most likely include red maple and yellow poplar.

Compartment	Stand	Forest Type	Age	Acres
399	18	Yellow poplar, White oak, Northern red oak	40	24
399	32	Yellow poplar, White oak, Northern red oak	31	24
399	34	Yellow poplar, White oak, Northern red oak	40	29
504	19	Yellow poplar, White oak, Northern red oak	24	41
504	25	White oak, Yellow poplar, White pine	34	25
504	27	Yellow poplar, White oak, Northern red oak	33	24
504	29	Yellow poplar, White oak, Northern red oak	24	30
505	17	Yellow poplar	26	22
			Total	**219**

Herbicide Use - Alternative 3 includes the use of herbicides for connected site preparation, release and midstory control treatments in certain restoration and maintenance treatment areas. A total of 1327 acres of herbicide use is proposed. Unlike Alternative 2, no herbicide use is planned for stands proposed for the oak/oak-pine thinning, pine-pine/oak thinning, or release. Although the majority of the treatment is proposed for upland areas, in order to protect aquatic resources, only aquatically labeled herbicides will be used.

Early Successional Forest Habitat: 1) Site preparation: In areas proposed for oak restoration through the planting of oak seedlings, harvested areas would be site prepared for regeneration using a combination of foliar and/or cut-stump methods through directed applications of triclopyr herbicides. Treatments would be directed at non-desirable woody vegetation remaining on site following the commercial harvests - typically stump sprouting vegetation less than 6 feet tall (foliar method) or standing trees from 1 inch to 8 inches dbh (cut-stump method). 2) Release: Connected release treatments would be employed in areas proposed for regeneration to promote growth of planted or naturally regenerating oak seedlings. Planted and/or naturally regenerated oaks would be released one or more times by directly applying triclopyr herbicides to competing vegetation within a three to four foot radius of seedlings using the foliar method.

Woodland Restoration: In areas proposed for woodland restoration, both with commercial harvest and without (non-commercial), midstory vegetation may be treated with herbicides to create a more open understory environment. Midstory vegetation would be treated using a combination of foliar and/or cut-stump methods through directed applications of triclopyr herbicides. Foliar methods would be employed to treat stump sprouting vegetation and other woody vegetation less than 6 feet in height. Cut-stump methods would be used for taller vegetation.

Midstory Control: In areas proposed for mid-story vegetation control, midstory vegetation would be treated with herbicides to increase natural oak regeneration. Midstory vegetation would be treated using either injection or cut-stump methods through direct applications of triclopyr herbicides.

Estimated herbicide rates to be applied under the proposed herbicide treatments are shown below. These rates will be the basis for the risk assessment analysis which is disclosed in Chapter 3.

Herbicide	Application Method(s)	Lbs ai/gal	% (fraction) in solution	Gallons of solution/acre	Lbs ai/acre
Triclopyr (amine)	Cut-stump	3.0	50%	1.0	1.5
Triclopyr (amine)	Injection	3.0	50%	1.0	1.5
Triclopyr (amine)	Foliar	3.0	4%	15	1.8

Prescribed Fire: These control burns would be implemented by hand and/or aerial ignition methods on a landscape scale, with the desired goal of a mosaic burn pattern. High to moderate fire intensities are desired for the south and west-facing xeric ridges, with moderate intensity fire on the midslopes. Low intensity backing fires will be used adjacent to trails and in riparian areas and mesic hardwood stands, allowing the fire to burn naturally. A site-specific burn plan would be prepared for each burn unit. This plan will describe the weather and fuel conditions under which the burn could be safely executed and consider the effects of the fire on other resources, including smoke impacts. All bladed dozer lines used to contain the burns would be re-vegetated and meet best management practices, after the burn is conducted, using a non-invasive grass mixture that is best suited to the area, time of year and benefit to wildlife. The preferred fire lines will consist of existing roads, streams, and constructed hand line while limiting and reducing the amount of bladed dozer line.

Burning would take place during both the dormant and growing season to achieve the desired fire conditions. The dormant season is defined as approximately November 1st through April 15th, with the primary implementation period being February through March. The growing season is approximately April 16th through October 30th, with the preferred time being April 16th through May. After initial treatments, a 3-5 year prescribed fire rotation is expected to be necessary to continually maintain the desired conditions. Project level vegetation monitoring will be used to determine exactly when and how many prescribed burns are needed to maintain the fire adapted habitats within these burn units.

Prescribed Burn Block Name	**Acres**	**Season**
Addie Gap	551	Growing/Dormant
Bryant Creek	1,375	Growing/Dormant
Coosa Bald	2,143	Growing/Dormant
Duncan Ridge (3 Units)	647	Growing/Dormant
Rich Ridge	1,161	Growing/Dormant
Spencer Mtn	1,502	Growing/Dormant
Fish Knob	1,764	Growing/Dormant
Cliff Ridge	1,543	Growing/Dormant
Dunsmore Mtn	1,156	Growing/Dormant
Total	11,842	

(2) Road Access

System Road Reconstruction: This will include curve widening/realignment to accommodate timber haul activities, reshaping of the road template to restore proper drainage, and as needed, replacement of

existing culverts and drainage structures to address present and future resource needs and Best Management Practices (BMP's).

Road Name	Road Number	Estimated Mileage
Mulky Gap	4	**0.25**
Cooper Creek	33	**0.25**
Bryant Creek	33A	**0.75**
Duncan Ridge	39	**0.25**
Burnett Creek	261	**0.75**
Gillespie Branch	287	**0.75**
Total		**3.0**

Temporary Road Construction: To provide access for the commercial vegetation management treatments, up to 5 miles of temporary roads will be constructed, the majority of which will utilize previous temporary road templates. These roads will be closed and re-vegetated after use.

Year-round and Seasonal Closures and Changes in Road Maintenance Levels: The Chattahoochee-Oconee National Forests recently completed a Travel Analysis Process (TAP) that identified a target road system needed for safe and efficient travel and access while also allowing for the protection, management, and use of the National Forest. This target road system is also an effort by the agency to more closely align the current transportation network with existing program capacities. Based on this analysis and other resource considerations, a number of system roads in the Cooper Creek Watershed have been proposed for year-round and/or seasonal closure, or administrative changes in the road Maintenance Level.

Year-Round Closure: Burnette Gap (FDR 108) and Mark Helton Branch (FDR 33B) would be closed year-round to all vehicular traffic (both administrative and public). Duncan Ridge Branch (39B) would be closed year-round to public vehicular traffic. All are dead-end roads that receive limited use. The closure of these roads to vehicular traffic would reduce maintenance requirements down to basic custodial care.

Road Name	Road Number	Estimated Mileage
Burnette Gap	108	2.4
Mark Helton Branch	33B	4.5
Duncan Ridge Branch	39B	2.2
Total		**9.1**

Seasonal Closure: The following roads or segments of these roads would be closed to public use from approximately January 1 to March 15 – the exact dates will be weather dependent. These roads would be closed during this time period of unfavorable weather where a combination of conditions and use results in the rapid deterioration of the road template, resulting in a public safety hazard as well as significant resource damage.

Road Name	Road Number	Estimated Mileage
Flatlands	637	1.5
Knight Creek	264A	2.9
Longcove Creek	264B	1.2
Gillespie Branch	287	2.0
Dixon Branch	88	3.7

Road Name	Road Number	Estimated Mileage
Duncan Ridge (portion)	39	3.0
Bryant Creek	33A	3.3
Sea Creek	264	4.0
Total		**21.6**

Changes in Road Maintenance Levels: The road maintenance levels would be changed for the following roads. These changes would more accurately reflect the current level of maintenance for roads within the Lake Winfield Scott Recreation Area and would also implement maintenance level objectives identified by the Chattahoochee TAP.

Road Name	Road Number	Mileage	Change in ML*
Lake Winfield Scott Branch C	37C	0.1	ML 2 to ML 4
Lake Winfield Scott Branch D	37D	0.2	ML 2 to ML 3
Duncan Ridge	39	2.0	ML 2 to ML 3
Burnett Gap/Calf Stump	108	2.4	ML 2 to ML 1
Mark Helton Branch	33B	4.5	ML 2 to ML 1
Total		**9.2**	

***ML1- Closed to all motor vehicle use including administrative traffic, suitable for non-motorized uses.**
ML2- Maintained for use by high-clearance vehicles and not suitable for passenger cars.
ML3- Maintained to be passable to prudent drivers in passenger cars during the normal season of use.
ML4- Maintained to provide a moderate degree of user comfort and convenience at moderate travel speeds for prudent drivers in a standard passenger car during normal season of use.

Road Decommissioning: The following roads or segments of these roads would be decommissioned by establishing vegetation and, if necessary, initiating restoration of ecological processes interrupted or adversely impacted by the unneeded road. Decommissioning includes applying various treatments, including one or more of the following:

1. Reestablishing former drainage patterns, stabilizing slopes, and restoring vegetation;
2. Blocking the entrance to a road or installing water bars;
3. Removing culverts, reestablishing drainages, removing unstable fills, pulling back road shoulders, and scattering slash on the roadbed;
4. Completely eliminating the roadbed by restoring natural contours and slopes; and
5. Other methods designed to meet the specific conditions associated with the unneeded road.

Road Name	Road Number	Estimated Mileage
Burnett Gap	108	0.6
Fortenberry	395	2.1
Total		**2.7**

(3) Expansion of Parking Lots

The Georgia Department of Natural Resources - Wildlife Resources Division has requested the expansion of the parking lot at the Cooper Creek Check Station on FSR #4 (Mulky Gap). Existing parking at the site is not adequate to accommodate the large number of vehicles for participants in the annual adult-child hunt each October, resulting in traffic problems and safety concerns. The existing parking lot would be expanded by approximately ½ acre. In addition, the existing trailhead parking at Addie Gap on FSR 33A (Bryant Creek) would also be expanded to approximately ½ acre to improve parking conditions for recreationists.

2.3 Alternatives Considered but Eliminated from Detail Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative actions. Some of these alternatives may have been outside the scope of the project, duplicative of the alternatives considered in detail, or determined to not achieve the purpose and need.

Alternative that: avoids any existing old-growth forest; does not cut other mature oak trees; avoids commercial logging or activity in preparation for future commercial logging in prescription 7.E.1; avoids tree cutting in the riparian corridor prescription 11; does not allow whole tree removal; focuses solely on sound, scientifically supported ecological restoration which is appropriate for the site proposed. No impacts to existing old-growth forests or whole tree harvesting are proposed. The restrictions on forest management activities proposed in this alternative would not meet the purpose and need for the project for a number of reasons including: 1) eliminating the cutting of mature oaks would limit the ability to provide early successional forest habitat and create young oaks stands for the future 2) Commercial logging and non-commercial activities are permitted in Management Prescriptions 7.E.1(Dispersed Recreation Areas) and 11 (Riparian Corridors) to meet Forest Plan Goals and Objectives which would be substantially reduced if restricted in this manner.

Early Successional Forest Habitat should be created by cutting down existing 30-40 year old clearcut stands. The cutting of these young stands is not commercially viable due to the small diameter of the trees to be cut. As a result, this would be a non-commercial operation with the material left on site. Cut and leave in these stands would not meet the purpose and need of the project related to the creation of early successional forest habitat for a variety of reasons including 1) the large quantity of material left on the ground would substantially impede the regeneration of the stand limiting its value as early successional forest habitat and 2) this material on the ground would also restrict the movement of wildlife into the stands limiting their utility to wildlife.

Clearcutting utilizing cable harvest should be included to allow harvest on steeper slopes. Given appropriate site conditions, cable logging can be a very efficient and environmentally sound method of timber harvest and the opportunity to utilize cable logging was evaluated in the Cooper Creek project. However, due to limitations of topography, access, and stand conditions, no opportunities for the use of cable logging systems were identified.

2.4 Project Design Features and Mitigation for Resource Protection

In response to public and resource specialist comments on the proposal, design features and mitigation measures were developed to minimize or eliminate any potential adverse effects from any of the proposed alternatives to any of the resources in the project area. Design features and mitigation that apply to the project include the following:

Table 2.4.1. Design features and mitigation measures incorporated into the action alternatives

Resource	Design Feature/Mitigation Measure
	Temporary roads would be constructed on previous exiting routes (old woods roads or skid trails) where possible to minimize the need for new temporary road construction.
	Temporary roads would follow the general contour as practical and would generally not exceed sustained grades over 10%.
	The travel way of temporary roads would generally not exceed 14-16 feet except at turnouts and landings.

Resource	Design Feature/Mitigation Measure
Soil and Water .	Drainage structures, such as outsloping and waterbars, would be installed along temporary roads when the use of the road is no longer needed
	Once the temporary roads are no longer needed, they would be closed to normal vehicle traffic and illegal ATV use would be discouraged. The closures may include such things as the installation of an earthen barrier, re-contouring, placement of logging debris along the road surface, or placement of boulders.
	Skid trails would be closed at their junction with landing sites by placing slash on the skid trail in order to discourage illegal ATV use.
	Log landings and skid trail locations would be evaluated and approved by the Forest Service prior to harvesting in order to ensure that they are placed in locations with adequate drainage and away from sensitive soils or riparian areas.
	Skidding and decking would be limited to designated and approved routes along ridges and gentle slopes to protect sensitive soils. Skidding would not be allowed on sustained slopes over 35%.
	Operation of ground-based equipment would only be allowed when soils are dry. Soil moisture would be assessed during harvest operations to determine periods when equipment should be halted to minimize compaction and rutting.
	Skid trails, log landings, temporary roads, or other areas of exposed soil, would be seeded and fertilized as soon as practical after harvest activities have been completed in order to restore vegetative cover and reduce the potential for erosion.
	Water bars would be installed on skid trails and temporary roads at the completion of the project to minimize the potential for erosion.
	Compacted soils on skid trails, temporary roads, and log landings would be ripped or tilled in areas of detrimental soil compaction to maintain soil quality standards and increase water infiltration.
	Sensitive soils discovered during timber sale layout would be protected by restricting access or activities in these areas.
	Water diversion structures would be installed on prescribed fire control-lines to prevent erosion
	Where prescribed burn control-lines enter or cross the Riparian Corridor, hand constructed fire-lines would be used to minimize soil disturbance.
Pesticide Use	See Appendix H
	A no-herbicide SMZ of 25 feet for artificial channels such as roadside ditches that have hydrological connectivity to waters of the state.
	No herbicide is ground-applied within 60 feet of any known locally rare plant. Buffers are clearly marked before treatment so applicators can easily see and avoid them. Selective applications to control competing vegetation within this buffer designated to protect locally rare plants may occur when needed to protect the locally rare plants from encroachment by invasive plants and when a non-soil active herbicide is used.
Riparian Areas	Skidding would not occur within riparian corridors, except at designated crossings.
	Harvest activities in riparian corridors would take place under dry soil conditions.
	Where streams are used as natural control-lines for prescribed burning, only low intensity fire would be allowed in the Riparian Corridor to mimic a natural burn mosaic.
Heritage Resources	Cultural resource sites would be protected with a 50 foot buffer, where no ground disturbing activities would occur within that buffer. The location of these sites would be shown on the ground to the District Timber Management Assistant and the District Fire Management Officer.
Biological Resources	Mitigate soil disturbing activities in a manner that would avoid negative impacts to rare plant species

Resource	Design Feature/Mitigation Measure
Non-native Invasive Species (NNIS)	High priority infestations of invasive plant would be pre-treated prior to disturbance created by project activities, when possible, in order to prevent the increase and spread of invasive plants. Known high-priority species include Oriental bittersweet (*Celastrus orbiculatus*), autumn olive (*Elaeagnus umbellatum*), Chinese privet (*Ligustrum* sp.), multiflora rose (*Rosa multiflora*), and Japanese Meadowsweet (*Spiraea japonica).*
	Logging decks would be surveyed for NNIS prior to harvesting. Any NNIS located adjacent to planned logging decks would be treated prior to disturbance, in order to greatly reduce the potential for spread.
	Equipment cleaning would be required in order to minimize the spread of invasive plants and to minimize the potential to introduce new invasive plants to the area.
	Skidding through known populations of invasive plants should be avoided, where possible, to reduce the potential for spread.
	Skid trails, log landings, temporary roads, or other areas of exposed soil, would be seeded (with either native species or non-native non-invasive species) as soon as practical in order to restore vegetative cover and reduce the potential for erosion. Fertilizer should only be in areas without presence of invasive species or reseeding with native perennial species.
	Consider using hay from native perennial grass species. Use hay and mulch from weed-free sources if possible or use hay from non-invasive species.
Vegetation Management/ Wildlife	Even-aged regeneration harvests would be limited to 40 acres in size
	Snags would be retained within regeneration harvest units in a manner to comply with Indiana Bat standards as well as other Federally-listed bat species. Specific mitigations are listed in the Rare Species Effects Analysis (Chapter 3).
Visual Quality	See Appendix J
Recreation	Felling operations within 200 feet of the Duncan Ridge Trail, Duncan Ridge Road and Mulky Gap Road would be limited to weekdays to reduce conflicts with recreational users. Hauling operations would be limited to weekdays only as well
	Coordinate with District recreation staff and post advance notices when hiking trails are to be closed during felling operations and prescribed burning.
	Vegetation management activities will not utilize existing trails as access routes, with the exception of a portion of the Shope Gap Trail. The trail would be restored to the original trail width and character upon project completion. Character trees/blaze trees that define the trail corridor would not be cut unless to mitigate safety concerns.

2.5 Monitoring and Evaluation

Monitoring and evaluation would occur under Alternatives 2 and 3. Monitoring and evaluation are separate, sequential activities. Monitoring involves collecting data by observation or measurement. Evaluation involves analyzing and interpreting monitoring data. Data would be collected according to Forest Service policy and direction.

Two types of monitoring would be conducted on the Cooper Creek Watershed Project area:

- **Implementation**: Did we do what we said we would do in the Project Area? Were activities implemented as planned and meet the desired conditions?
- **Effectiveness**: Were the planned activities and mitigations effective in meeting goals and objectives?

The main goal of monitoring and evaluation is to assess project implementation and compliance with Forest Plan direction. It provides a reporting system so the Forest Supervisor, District Ranger, Forest Staff, and the public can openly follow the success or failure of a project and implementation of the Forest Plan.

Monitoring is conducted by various resource areas involved in project activities. Monitoring methodologies or protocols are established by each resource area with requirements for the sample size, method and frequency of collection, data recording and filing, and assessment.

The Cooper Creek Watershed Project Monitoring Plan is displayed in Appendix I. Monitoring items are listed by resource area, identified as implementation or effectiveness, have a stated objective, and a source of protocols.

2.6 Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in table 2.2 is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 2.6.1 Comparison of alternatives in meeting purpose and need of project.

Item	Measurement	Alternative 1: No Action	Alternative 2: Proposed Action	Alternative 3:
Maintain oak-pine forest	Acres of stands thinned to maintain oak-pine forest, mid-story and release treatments	0	1,428	678
Restore oak-pine forest	Acres of white pine thinning and existing pine stands regenerated to oak	0	891	805
Improve wildlife habitat by providing a diversity in successional stage habitats	Acres of early successional forest habitat created through regeneration	0	253	249
Restore and maintain woodland communities	Acres of stands mechanically treated to restore open woodland	0	764	720
Increase Structural Diversity in Mesic Hardwood stands	Acres Treated with Canopy gaps	0	466	204
Restore and maintain woodland communities, oak and pine communities and improve wildlife habitat	Acres of landscape treated with prescribed fire	11,842 (dormant season only)	11,842 (dormant and growing season)	11,842 (dormant and growing season)
Soil and Water Conditions Improved	Miles of road reconstructed	0	3.0	3.0
Soil and Water Conditions Improved	Miles of road closed year round to vehicular use	0	6.7	9.1
Soil and Water Conditions Improved	Miles of road restricted to seasonal use	0	21.6	21.6
Soil and Water Conditions Improved	Miles of roads decommissioned	0	0	2.7

Table 2.6.2. Comparison of treatment acres/miles by Alternative

	Alternative 1: No Action	Alternative 2: Proposed Action	Alternative 3
VEGETATION MANAGEMENT			
Commercial			
Oak/ Oak-Pine Thinning	0	112	101
Pine/Pine-Oak Thinning	0	843	740
Canopy Gap Thinning	0	466	100
ESFH	0	253	249
Woodland	0	641	489

Total Commercial	**0**	**2,315**	**1,679**
Non-Commercial			
Thinning	0	123	231
Canopy Gaps	0	0	104
Midstory	0	1.056	358
Release	0	260	219
Total		**1,439**	**912**
Acres of Herbicide Use	0	3,251	1,327
Acres of Prescribed Burning	11,842	11,842	11,842
ROAD ACCESS			
System Road Reconstruction	0	2.8	3.0
Temporary Road Construction	0	5	5
Year-round Closure	0	6.7	9.1
Seasonal Closure	0	21.6	21.6
Changes In Maintenance Level	0	0.3	9.2
Decommissioning	0	0	2.7
Parking Lot Expansion (acres)	0	0	1

CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparison of alternatives presented in the chart above.

3.2 Past, Present, and Reasonably Foreseeable Future Actions

Each resource section includes a discussion of cumulative effects focused on evaluating the effects of the proposed action in context with relevant effects from past, present, and reasonably foreseeable actions. Past, present, and foreseeable future actions considered in the cumulative effects analyses will vary for each resource. Relevant actions are those expected to generate effects on a specific resource which will occur at the same time and in the same place as effects from the proposed action. Past and present activities are considered part of the existing condition and are discussed in the "Affected Environment (Existing Conditions)" and "Environmental Consequences" section under each resource.

The analysis of cumulative effects is consistent with the direction provided in the 36 CFR 220.4(f). There is a summary in the next paragraph about the recently past, present (or ongoing), and reasonably foreseeable activities within or near the general area of the *Cooper Creek Watershed Project* that could contribute relevant effects (i.e., effects that overlap in space and time with effects of the proposed action). The analysis for each resource may not consider all actions listed below or it may consider additional actions not listed.

Table 3.2.1 displays the known past, present, and reasonably foreseeable future actions on National Forest System lands within the Cooper Creek Watershed Project Area that may contribute cumulatively to the direct and indirect effects of proposed Cooper Creek Watershed Project activities. The table includes activities during the last decade.

Table 3.2.1. Past present, and Reasonably Foreseeable Activities in the Cooper Creek Watershed.

Activity	Year(s) Implemented	Acres /Miles Affected	Past	Present	Reasonably Foreseeable
Cooper Creek ESH Project	2004-5	90 acres	X		
Cooper Creek Cerulean Warbler Project	2004-5	100 acres	X		
Midstory Control	2011	630 acres	X		
Addie Gap Rx Burn	1998, 2010	551 acres	X	X	X
Bryant Creek Rx Burn	1999	1,375 acres	X	X	X
Coosa Bald Rx Burn	1999, 2013	2,143 acres	X	X	X
Duncan Ridge Rx Burn (3 Units)	-	647 acres			X
Rich Ridge Rx Burn	1999, 2010,2014	1,161 acres	X	X	X
Spencer Mtn Rx Burn	-	1,502 acres			X
Fish Knob Rx Burn	1999, 2004, 2011	1,764 acres	X	X	X
Cliff Ridge Rx Burn	2003, 2012	1,543acres	X	X	X
Dunsmore Mtn Rx Burn	2011	1,156 acres	X	X	X
Wildlife Opening Maintenance	annual	70 acres	X	X	X
Road Maintenance	annual	20 miles	X	X	X
Fish Habitat Improvement (Pretty Br, Bryant Cr, Burnette Cr, Cooper Cr)	2000-present	5 miles	X	X	X
Bryant Creek Arch Culvert	2013	2 miles	X		

Activity	Year(s) Implemented	Acres /Miles Affected	Past	Present	Reasonably Foreseeable
Pretty Branch Arch Culvert	2016	2 miles			X
Dixon Branch Arch Culvert	2017	2 miles			X
Invasive Species Treatment	2008-Present	20 acres	X	X	X
Soil and Water Restoration	2000-Present	10 miles	X	X	X
HWA Control	2006-Present	100 acres	X	X	X
Duncan Ridge Trail Relocation	2016	5			X

3.3 Soils

Introduction

This section discloses the results of analysis of the soil resources of the Cooper Creek Watershed Project, located on the Blue Ridge Ranger District, Chattahoochee-Oconee National Forests, in Union County, Georgia. The project area includes lands within the Cooper Creek, Youngcane Creek, and Coosa Creek watersheds, located south of Blairsville, Georgia.

The proposed action involves timber harvest (commercial and non-commercial), prescribed burning, road improvements, and silviculture treatments. This analysis describes soils in terms of their formation, properties, limitations and potentials, and expected outcomes from proposed activities and alternatives.

Regulatory Framework

The Forest Service has developed a framework and methodology for the evaluation and determination of soil condition, quality and productivity within project areas. For the purpose of the National Environmental Policy Act (NEPA), soils are evaluated in the context of the Chattahoochee-Oconee National Forest Land Management Plan standards for soils, and Forest Service Southern Region Soil Quality Monitoring standards, summarized in the section below.

The regulatory framework providing direction for protecting a site's inherent capacity to grow vegetation and maintain soil productivity comes from the following principle sources:

- Organic Administration Act of 1897
- Multiple Use-Sustained Yield Act of 1960
- National Forest Management Act of 1976 (NFMA)
- Forest Service Manual 2500 – Chapter 2550 – Soil Management
- Forest Service Handbook FSH 2509.18 – Soil Management Handbook – Region 8 Soil Quality Monitoring
- Chattahoochee-Oconee National Forests Land and Resource Management Plan - 2004

The Organic Administration Act of 1887 (16 U.S.C. 473-475 authorizes the Secretary of Agriculture to establish regulations to govern the occupancy and use of National Forests and "….to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States."

The Multiple Use-Sustained Yield of 1960 directs the Forest Service to achieve and maintain outputs of various renewable resources in perpetuity without permanent impairment of the land's productivity.

The National Forest Management Act of 1976 (NFMA) charges the Secretary of Agriculture with ensuring research and continuous monitoring of each management system to safeguard the land's

productivity. To comply with NFMA, the Chief of the Forest Service has charged each Forest Service Region with developing soil quality standards for detecting soil disturbance and indicating a loss in long-term productive potential. These standards are built into Forest Plans. NFMA specifically states: Timber harvest on National Forest lands (16 USC 1604(g)(3)(E)): A Responsible Official may authorize site-specific projects and activities to harvest timber on National Forest System lands only where:

Soil, slope, or other watershed conditions will not be irreversibly damaged (16 USC 1604(g)(3)(E)(i).

The Forest Service Manual (FSM) 2500, Chapter 2550-Soil Management, establishes the framework for sustaining soil quality and hydrologic function while providing goods and services outlined in forest land management plans (FSM 2551 – Soil Quality Management, 2010).

Forest Service Southern Region (R8) Soil Quality standards (Forest Service Handbook FSH 2509.18-2003-2) were issued in September 2003. Handbook direction recommends that "At least 85 percent of an activity area is left in a condition of acceptable potential soil productivity following land management activities." (FSH 2509.18-2003-2, 4.a.) FSH 2509.18 soil quality standard 4 states: This condition is considered meeting minimum soil quality standards, when the physical, chemical, and biological properties of the soil are not significantly impaired.

Forest Plan Direction

The Chattahoochee-Oconee National Forests Land and Resource Management Plan (Forest Service, 2004) goal for soils is *Goal 24 – Maintain or restore soil productivity and quality* (page 2-20). This goal aligns with the current national direction for soils on National Forest System lands, to manage resource uses to sustain ecological processes and function so that desired ecosystem services are provided in perpetuity. (FSM 2550.2, 2010)

Forest and Regional Soil Quality Standards applicable to the proposed action of the Cooper Creek Project are displayed in Table 3.3.1.

Table 3.3.1 Regional and Forest Plan Standards – Soil Quality

Forest Plan Soil Standard FW-065 [1]	On all soils dedicated to maintaining forest cover, the organic layers, topsoil, and root mat will be left intact over at least 80 percent of an activity or project area.
Forest Plan Soil Standard FW-066 [1]	Water control structures necessary for the control of surface water movement resulting from soil disturbing activities will be constructed within 30 days of completion of the activity.
Forest Plan Soil Standard FW-067 [1]	Mitigate bare soil exposure prior to any suspension of project activity for 30 days or longer.
Forest Plan Soil Standard FW-068 [1]	On all soils dedicated to growing vegetation, re-vegetation to appropriate species will be completed to a minimum of 85 percent coverage within the first growing season following the completion of the activity.
R8 FSH 2509.18 Soil Quality Standard 4 [2]	Soil impairment does not occur when the following are within limits:
	(a) At least 85 percent of an activity area is left in a condition of acceptable potential soil productivity following land management activities.
	(b) Compaction in an activity area should not significantly impair soil productivity. Since soil textures influence bulk

	density, the allowable change in bulk density should be determined for each soil type. A maximum 15 percent increase in bulk density, in the upper 8 inches of the soil, should be used as a guide for determining allowable change.
	(c) Soil rutting and puddling is a physical change in soil properties to shearing forces that destroy soil structure and reduce porosity. Rutting and puddling should be kept to a minimum as defined by the Forest.
	(d) Soil organic matter levels should be sufficient to prevent significant short or long-term deficits in the nutrient cycle. Soil organic matter should remain at least 85 percent of the natural or undisturbed total in the upper 6 inches of the soil.

[1]Chattahoochee-Oconee Forest Plan, page 2-22; [2]R8 FSH 2509.18, page 4

Analysis Methods

1. Analysis Area (spatial context)

Analysis of direct and indirect effects for soil quality and productivity was applied to the land area within the boundaries of proposed treatment units. The treatment unit is considered an appropriate geographic area for assessing direct and indirect environmental effects to soil resources because soil productivity is a site-specific attribute of the land and not dependent on the productivity of an adjacent area. For example, if one acre of land receives soil impacts – resulting in reduced soil porosity, water holding capacity, aeration, long-term productivity – and a second management activity is planned for the same site, then soil cumulative effects are possible. One exception that could require a closer evaluation of adjacent terrain outside of activity areas would be the potential impacts of slope stability to determine if cumulative effects from management activities and roads are detrimental. For these reasons a watershed approach was not applied to determine the cumulative effects to soil productivity. Assessing soil quality within too large an area can mask site-specific effects.

The analysis area for direct, indirect and cumulative effects on soil resources encompasses all land within individual treatment areas. Existing permanent National Forest System roads and trails are considered dedicated lands for other purposes and, as such, soil quality standards do not apply. Existing roads within units are considered for effects but those roads that are adjacent to units are not as they only border the unit. Cumulative effects to soils are those effects that overlap in time and space, so there would be no cumulative effects where there are no direct or indirect effects.

Methods Used

Existing conditions of soil resources were determined through on-site field visits, from past records of management activities, e.g. harvest, prescribed burning, roads, GIS data, and review of published soil survey information.

Field visits were completed in 2014 and 2015 to representative timber harvest units, road reconstruction sites and prescribed burning units proposed for treatment to evaluate existing conditions and identify potential soil disturbance challenges. On-site assessment included short transects in proposed treatment units to locate and evaluate evidence of impacts from past treatments, potential access routes, log landing sites and prescribed burn control lines that would require soil excavation or displacement during project treatments. Evaluations used visual indicators and shovel tests to determine soil properties, compaction effects, organic matter depths and any existing erosion issues.

3.3.1 Affected Environment

Project Area of Interest

The Cooper Creek Watershed project area is located in the central portion of Union County, Georgia in the upper headwaters of two river basins and three sixth (6^{th}) Level Hydrologic Units (HUC); Cooper Creek - HUC #060200020102 in the Toccoa River basin, Coosa Creek – HUC # 060200020505, and Youngcane Creek, HUC # 060200020506 in the Nottely River basin. The project area is bordered on the east by Blood Mountain, Coosa Bald, and Gaddis Mountain; on the south side by Rocky Mountain, Davis Mountain, a second Rocky Mountain and Licklog Mountain on the west side, and on the north side by Parker Knob, Mulky Gap, Bryant Gap and Buckeye Knob along a prominent feature, Duncan Ridge. The project area is accessed by Cooper Creek Road (FS 33), Mulky Road (FS 4), Duncan Ridge Road (FS 39), and on the east boundary by Georgia Highway 180 from Suches to Vogel State Park. Chapter 1 of this EA provides a detailed description on the area of interest. The project planning area encompasses the Cooper Creek watershed, approximately 25,290 acres in size, with National Forest lands on 23,445 acres (93%) and the remaining 1,845 acres being in private ownership. Coosa Creek watershed is 14,364 total acres, 6,386 of National Forest (44%) on the northeast portion of the project area with 7,978 private acres; and Youngcane Creek on the northwest portion is 20,717 acres total, 4,187 acres National Forest (20%) with 16,530 acres of private.

Union County totals 211,200 acres in all ownerships, or 330 square miles. The three 6^{th} level HUCs in the Cooper Creek watershed project comprise 60,731 acres total (95 square miles), or about 29% of the County area.

The proposed action is described in Chapter 1.4. In summary, commercial treatment activities would occur on 2,315 acres, non-commercial treatments on 1,439 acres, and prescribed burning on a total of 11,842 acres. A detailed description of the proposed action alternatives can be reviewed in Chapter 2.

In addition, to provide adequate road access to current standards, 2.8 miles of existing road will be reconstructed. Up to five (5) miles of temporary road will be constructed to access harvest areas, most on alignments used in previous treatment projects.

The purpose of the project activities in the three 6^{th} level HUCs is to:

- Restore native plant communities
- Encourage regeneration of Oak and Oak-Pine Forest communities
- Improve and enhance wildlife habitat conditions
- Improve forest health

A detailed description of the purpose and need for action can be found in Chapter 1.3 of this Environmental Analysis document.

A. Existing Condition

1. Soils and Geology

Soils are formed through the interaction of the five soil forming factors; parent material, climate, topography, organisms, and time. The following information is excerpted from the Fannin and Union Counties Soil Survey (NRCS 1996) providing a brief overview of soil formation in the county (pgs. 77-78).

Parent material, or geology, for the project area is generally mica schist and biotite gneiss. Some soils formed in old colluvium on the toe of slopes, or in old alluvium on stream terraces. Climate affects soil formation through its influence on the rate of weathering of rocks and on the decomposition of minerals and organic matter. Union County has a moist temperate climate with an average winter temperature of about 40 degrees F and an average summer temperature of about 73 degrees F. The warm moist climate promotes rapid weathering of hard rock. Consequently, in much of Union County the soils are from 2 to 4 feet thick over a layer of weathered rock that covers the underlying hard rock. Average annual precipitation is about 62 inches, evenly distributed throughout the year. Topography influences soil formation through its effect on water runoff, movement of water within the soil, plant cover and soil temperature. Soils on the steeper slopes have more runoff than soils in the less sloping areas. As a result, they are more susceptible to erosion. Soils on the steeper soils commonly are shallower or less developed than soils on the gentler slopes. Slopes in Union County range from nearly level along streams to very steep on mountainsides, e.g. Duncan Ridge north aspects in the project area. Organisms are active in soil forming processes; for example, growing plants that provide soil cover and protection. Decomposition of leaves, twigs and roots on the ground surface benefit nutrient levels in soils. Generally a long time is required for a soil to form; as long as 500 years to form one inch of productive soil. One inch of soil over one acre of land weighs about 160 tons. Most soils in Union County have distinct horizons with a surface layer, or topsoil, containing organic matter, underlain by layers of soil high in clay content. Most of the soils are well-drained with red or dark-red colored subsoils indicating the presence of highly oxidized iron. Poorly drained soils typically occur in flat, level areas near streams.

Table 3.3.3 provides a listing of the soil series classified and mapped in the project area, a brief description describing soil physical properties, and the acres of each series identified in the project area, based on GIS map analysis.

Table 3.3.2 Brief Description of Soil Series in Cooper Creek Project Area

Soil Series	Brief Description of Soil Series	Acres in Project Stands
Arkaqua	Arkaqua soils are somewhat poorly drained, located on floodplains with a slope range of 0 to 2%. Depth to root restrictive layer more than 60 inches, with a soil texture of loam. These soils are frequently flooded, but do not meet hydric criteria.	1.0
Bradson	Bradson soils are very deep (more than 60 inches to bedrock), well drained soils found in coves and toeslope positions. Surface soil texture is fine sandy loam over clay loam or clay subsoil. Slope range is 6 to 25%.	358.0
Chatuge	Chatuge soils are very deep, poorly drained, nearly level, deep to bedrock, and occurring along streams. Surface soil texture is loam over clay loam subsoil. Some portions of this soil can be classified as hydric, or wetland. These soils are occasionally flooded.	19.0
Chestnut	Chestnut soils are moderately deep, well drained, and located on sideslopes ranging from 10 to 60%. Depth to a root restrictive layer, bedrock, is 20 to 40 inches. Surface texture is loam over gravelly sandy loam subsoil.	271.0
Clifton	Clifton soils are very deep, well drained and located on sideslopes ranging from 10 to 25%. Surface soil texture is sandy loam over clay and clay loam subsoil, ranging from 30 to 40 inches deep to bedrock.	174.0
	Cowee soils are moderately deep, well drained, and on sideslopes	

Cowee	ranging from 25 to 45%. Surface soil texture is sandy loam over sandy clay loam subsoil, with depth to bedrock at about 40 inches.	828.0
Evard	Evard soils are very deep, well drained, and on sideslopes ranging from 25 to 45%. Surface soil texture is loam over clay loam or sandy clay loam, with depth to bedrock at 60 inches or more.	1/
French	French soils are very deep, moderately well drained or somewhat poorly drained on floodplains of mountain streams. These soils are in landscape positions that are frequently flooded. Surface soil texture is fine sandy loam over sandy loam subsoils with depth to bedrock from 20 to 40 inches.	29.0
Hayesville	Hayesville soils are very deep, well drained, and on sideslopes with slopes ranging from 10 10 to 45%. Surface soil texture is loam over clay loam or clay subsoil. Depth to bedrock is more than 60 inches.	332.00
Junaluska	Junaluska soils are moderately deep, well drained and on sideslopes or ridges ranging from 25 to 45%. Surface soil texture is loam over clay loam subsoil. These soils typically have 10% or more by volume channer size rocks in the soil profile. Depth to bedrock is 20 to 40 inches.	102.0
Porters	Porters soils are deep, well drained and on sideslopes with slopes ranging from 25 to 45% slopes. Surface soil texture is loam over sandy loam subsoil. These soils are commonly located on north facing aspects, have a thick surface horizon (7 to 10 inches) that is typically very dark grayish brown. Hard bedrock is at a depth of 40 to 60 inches.	562.0
Saunook	Saunook soils are very deep, well drained and located in mountain coves and toeslopes, with slopes ranging from 10 to 45% slopes. Surface soil texture is loam over clay loam subsoil with depth to bedrock of more than 60 inches.	980.0
Thurmont	Thurmont soils are very deep, well drained and located on stream terraces and toeslopes, with slopes ranging from 2 to 12%. Surface soil texture is sandy loam over gravelly clay loam subsoil with depth to bedrock of 40 to 60 inches.	47.0
Tsali	Tsali soils are shallow, often less than 20 inches to bedrock, well drained and on sideslopes, with slopes ranging from 25 to 45%. Surface soil texture is channery loam with about 20% gravel by volume. Subsoil texture is channery clay loam with 30%. channers by volume .	2/
Tusquitee	Tusquitee soils are deep, well drained and located in coves, toeslopes and around stream headwaters, with slopes ranging from 6 to 12%. Surface soil texture is loam through the subsoil with depth to bedrock more than 60 inches.	47.0

Acres are based on proposed treatment areas in the Proposed Action, Alternative 2. Soil descriptions from Web Soil Survey, NRCS 2014. Acres determined by GIS analysis of proposed action files. 1/ Acres are included in Clifton-Evard and Cowee-Evard complex map units. 2/Acres are included in Junaluska-Tsali complex map unit.

2. Ecological Classification

Ecologically the Cooper Creek Watershed Project is situated in the Blue Ridge Mountains Section (M221D), identified in the Forest Service National Hierarchical Framework of Ecological Units (Cleland et. al. 1993). The Blue Ridge Mountains Section is a lower level of the Hot Continental Division characterized by hot summers and cool winters.

Blue Ridge Mountains Section (M221D): formed by faulting and uplift of resistant, crystalline bedrock into a narrow band of highly metamorphosed, somewhat parallel mountain ranges. Landforms are generally described as low mountains. Soils are typically moderately deep and fine to medium

textured. Boulders and bedrock outcrops are common on upper slopes, but not extensive. Vegetation in this Section is commonly classified as Appalachian oak forest (USDA Forest Service, 1994).

The Cooper Creek project is included, at the project scale, in the Toccoa River landtype association (LTA), a lower level of the ECS hierarchy first described in 1995. The LTA is described as rugged mountainous terrain in the Blue Ridge Divide "rain shadow", generally north and northwest aspect slopes and ridges. Geology is mica schist/gneiss and biotite gneiss. Landforms include rugged mountain crests with numerous peaks above 3000 feet, with elevation range from 2200 feet to 3500 feet, average relief of about 650 feet. Average annual precipitation is about 62 inches with higher rainfall months from December to March. Growing season is approximately 238 days. The LTA description also mentions cultural influences of woods burning and grazing in the Mulky Creek watershed in the 1850s, and commercial logging in the 1880s, with a chestnut bark camp at the mouth of Buckhorn and Millshoal Branch before 1857. Forest Service acquisition began in the 1920s.

Watershed Condition Classification

A watershed assessment was completed Forest-wide on the Chattahoochee-Oconee National Forests in 2011 as part of the Forest Service Watershed Condition Framework. Assessment was conducted at the scale of 6th level hydrologic units (HUC 12). A core set of national watershed condition indicators was used to classify watershed conditions, including soil condition, part of the terrestrial physical ecosystem process category. Analysis evaluated available GIS and local data to consider how management actions can affect the conditions of watersheds and associated resources. The soil indicator addresses alteration to natural soil condition, including productivity, erosion and chemical contamination (USDA-FS, 2011). Indicators were evaluated using a defined set of attributes whereby each attribute was scored as Good (functioning properly), Fair (Functioning at risk), or Poor (impaired function).

Soil condition in the three 6th level hydrologic unit (HUCs) was rated as Fair (1.7 to 2.0) or functioning at risk. The condition rating rule set in the Watershed Condition Classification Technical Guide describes this condition as "Moderate amount of alteration to reference soil condition is evident. Overall soil disturbance is characterized as moderate." Most of this disturbance is the result of past management activities such as timber harvesting, road construction and maintenance, fire, and recreation use. Ground-disturbing activities from forest management practices have the greatest change in impacting soil productivity through erosion, compaction, rutting, soil displacement and removal of the organic surface. Soil productivity is described as "Soil nutrient and hydrologic cycling processes are impaired and the ability of the soil to maintain resource values and sustain outputs is compromised in 5 to 15 percent of the watershed."

Soil Survey and Inventory

The Fannin and Union Counties Soil Survey provides soils information for the project area, published cooperatively in 1996 by the USDA Natural Resources Conservation Service, USDA Forest Service and University of Georgia. Soil survey information includes descriptions of soil series and soil map units, soil maps, and interpretations for various management uses. Maps and data can be obtained online at the NRCS Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/HomePage.html.

Soil scientists traverse the landscape during mapping to inventory and classify soils into soil map units that identify soils with similar properties and characteristics. These soil map units describe and delineate the soil characteristics of an area and provide a method to identify hazards, limitations, or potentials to be considered when designing and implementing land treatment activities. Key soil properties evaluated during field surveys include slope steepness, soil depth over bedrock, soil texture and structure, drainage, landform position, and other physical properties that could influence soil

productivity and management. Landform features that may limit use and management are also noted; e.g. stony areas, wetlands, floodplains, steep slopes. Slope gradient ranges in the project area soil map units are identified as 0 to 2 percent slopes (primarily on floodplains and streams), 2 to 12 percent on gently sloping sideslopes, 10 to 25 on moderately steep slopes, 25 to 45 percent on steep slopes and 45 to 60 percent or greater on very steep slopes.

Three soil mapping units in the project stands occur within riparian areas of the larger perennial streams within the Cooper Creek landscape; Arkaqua loam (Aa), Chatuge loam (Ch) and French fine sandy loam (Fr). Total acres in these mapping units are 48 acres. Arkaqua and French are rated with frequent flooding, typically in the months of December to April, with short duration flood events.

Chatuge soils are rated as occasional flooding, less frequent. Chatuge soils are rated as poorly drained, with a seasonal high water table at 18 inches from December to April, and also meet the criteria for hydric soils, potentially supporting wetlands. These soils are characterized by loamy textures and permeability is moderate. Water tables would typically be within 1-2 feet of the soil surface during the wetter winter and early spring months. Management operations can be implemented on these soil map units by identifying drier periods of the year for limited equipment use.

Table 3.3.3 displays the name, map unit symbol, map unit slope gradient range (%), acres in project activity stands, and percent of project stands.

Table 3.3.3 Soil Map Units in the Cooper Creek Project Area

Soil Map Unit Name	Map Unit Symbol	Map Unit Slope Gradient (%)	Acres In Project Activity Stands	Percent of Project Activity Stands
Arkaqua loam, frequently flooded	Aa	0 to 2	1.0	0
Bradson loam	BrC	6 to 10	1.78	0
Bradson loam	BrE	10 to 25	356.67	9.5
Chatuge loam, occasionally flooded	Ca	1 to 2	19.15	0.5
Chestnut loam	CeE	10 to 25	19.92	0.5
Chestnut loam, stony	ChF	25 to 45	128.57	3.0
Chestnut loam, stony	ChG	45 to 60	122.30	3.0
Clifton-Evard complex	ClE	10 to 25	174.29	5.0
Cowee-Evard complex	CxF	25 to 45	742.34	20.0
Cowee-Evard complex	CxG	45 to 60	85.43	2.0
French fine sandy loam, frequently flooded	Fr	0 to 2	28.75	0.7
Hayesville fine sandy loam	HaE	10 to 25	167.36	4.0
Hayesville fine sandy loam	HaF	25 to 45	164.79	4.0
Junaluska-Tsali complex	JtF	25 to 45	102.30	3.0
Porters loam, stony	PsF	25 to 45	511.28	14.0
Porters loam, stony	PsG	45 to 60	40.38	1.0
Saunook-Evard complex	SaE	10 to 25	806.70	22.0
Saunook-Evard complex, stony	SnF	25 to 45	161.05	4.0
Saunook-Porters complex, stony	SpG	45 to 60	12.68	0.5
Thurmont fine sandy loam	ThB	2 to 6	40.62	1.0
Thurmont fine sandy loam	ThC	6 to 12	6.68	0.5

Tusquitee loam	TlC	6 to 10	47.40	1.0
Total Acres in project activity stands			3741.34	

Acres are based on GIS analysis of proposed treatment areas in the Proposed Action, Alternative 2.

Soils of Concern

The Cooper Creek watershed project area exhibits typical Southern Appalachian Blue Ridge Mountain terrain; high peaks, sharp relief, and steep sideslopes (Edwards, et. al. 2013). Valleys are often 1,500-2,000 feet below the adjacent summits. Slope gradients range from 0 to 90 percent, but are mainly 10 to 45 percent (NRCS, 1996). A dominant geology in the Cooper Creek watershed is the biotite gneiss/metagraywacke which provides the underlying bedrock for the Evard-Cowee-Saunook, and Porters-Chestnut-Saunook general soil map units (NRCS, 1996). This geology is often steeply inclined, creating steep slopes.

A combination of soil and site physical properties or characteristics in five soil map units identify "soils of concern" for the project area. These soil map units require additional consideration and management throughout the various phases of activity to maintain or enhance soil quality and productivity in its existing condition. These map units are: Chestnut loam, stony (ChG), Cowee-Evard complex (CXG), Junaluska-Tsail complex (JtF), Porters loam, stony (PsG), and Saunook-Porters complex (SpG). The properties of concern are related to very steep slope gradient, 45% or higher, exposed stones on the soil surface, and soil moisture conditions. These map units generally occur on the upper portion of sideslopes near the crest of mountain ridges, often with headwater streams flowing through the units. These soil map units have high erosion potential, slope failure potential and present challenges to equipment operation. Chestnut loam, stony (ChG) and Junaluska-Tsail complex (JtF) are also shallow to bedrock (20 to 40 inches) which can be a potential challenge in road construction. The Chestnut (ChG) and Porters (PsG) soil map units have stones (12-20 inches in diameter) about every 75 feet apart on the surface, potentially creating difficulty in equipment maneuverability across the map unit, in addition to the very steep slope gradient. Porters soils, deep over bedrock, typically occur on the north facing aspects of the higher mountains which may have springs under the surface that can present problems when exposed through road or skid trail excavation.

Areas of these soils occur primarily on the upper sideslopes of Bowers Mountain and the prominent Duncan Ridge. Based on GIS analysis of the soil maps for the project area, slopes over 45% occur on about 350 acres; with about 10% of the total acres identified for commercial and non-commercial treatments in the proposed action.

Possible Design Criteria to consider on these soils of concern include pre-operation location and design of access routes, avoiding existing or predicted unstable slope areas where possible, installation of adequate road drainage during and after operation periods, and prompt rehabilitation of disturbed or excavated soils to restore protection from storm flow and maintain soil productivity.

Proposed action stands with areas of slopes over 40% were field evaluated by District timber management personnel to assess ground based equipment operation challenges and during soil analysis to identify existing and potential limitations. Stand boundaries were modified to minimize ground disturbance on steep slopes in excess of 45%. Temporary roads are identified on approximately 0.7 miles on ChG and JtF soil map units; on existing alignments. These road prisms are in stable condition and can be re-established for use in the proposed action with minimal disturbance. Soil analysis identified no existing concerns on the soil map units over 45%; e.g. landslides, active erosion, etc.

Table Soil-4 displays interpretations for timber harvest activities for the soil map units inventoried and delineated in the Cooper Creek proposed action stands. The table displays the soil map units by slope gradient ranges to identify acres in these categories. Soil interpretations related to use of ground based equipment, excerpted from NRCS soil survey include interpretations of hazard or risk for erosion hazard, rutting, harvest equipment operability, road suitability (natural surface) and log landing suitability. Detailed descriptions of these interpretations are in the project file for the Cooper Creek project.

Table 3.3.4 Interpretations for Timber Harvest Operations

Soil Mapping Unit Name, slope gradient	Map Unit Symbol	Erosion Hazard (off-trail, off-road)	Soil Rutting hazard	Harvest Equipment Operability	Road Suitability (natural surface)	Log Landing suitability	Total Acres by Soil Map Unit
A-Riparian Soils 0 to 2 % slope gradient							
Arkaqua loam, frequently flooded	Aa	slight	Moderate	Well suited	Poorly suited	Poorly suited	1.0
Chatuge, occasionally flooded	Ca	Slight	Severe	Moderately suited	Moderately suited	Moderately suited	19.15
French fine sandy loam, frequently flooded	Fr	Slight	moderate	Well suited	Poorly suited	Poorly suited	28.75
B – Upland Soils – 2 to 12% slope gradient							
Bradson loam 6 to 10%,	BrC	slight	Severe	Moderately suited	Moderately suited	Moderately suited	1.78
Thurmont fine sandy loam, 2 to 6 %, 6 to 12%	ThB	Slight	Moderate	Well suited	Well suited	Well suited	40.62
Tusquitee loam, 6 to 12%	TlC	Slight	Severe	Moderately suited	Moderately suited	Moderately suited	50.60
C – Upland Soils – 10 to 25% slope gradient							
Bradson loam, 10 to 25%	BrE	moderate	severe	Moderately suited	Poorly suited	Poorly suited	356.67
Chestnut loam, 10 to 25%	CeE	moderate	Moderate	Well suited	Poorly suited	Poorly suited	19.92
Clifton-Evard complex, 10 to 25%	ClE	moderate	Severe	Moderately suited	Poorly suited	Poorly suited	174.29
Hayesville fine sandy loam, 10 to 25%	HaE	Moderate	Moderate	Well suited	Poorly suited	Poorly suited	167.36
Saunook-Evard complex, 10 to 25%	SaE	Moderate	Moderate	Well suited	Poorly suited	Poorly suited	806.70
D – Upland Soils – 25 to 45% slope gradient							
Chestnut loam, stony, 25 to 45%	ChF	Moderate	Moderate	Moderately suited	Poorly suited	Poorly suited	128.57
Cowee-Evard complex, 25 to 45%	CxF	Moderate	moderate	Moderately suited	Poorly suited	Poorly suited	742.34
Hayesville fine sandy loam, 25 to 45%	HaF	Moderate	Moderate	Moderately suited	Poorly suited	Poorly suited	164.79
Junaluska-Tsali complex, 25 to 45%	JtF	Moderate	Severe	Moderately suited	Poorly suited	Poorly suited	102.30
Porters loam, stony, 25 to 45%	PsF	Moderate	Severe	Moderately suited	Poorly suited	Poorly suited	511.28
Saunook-Evard complex, 25 to 45%	SnF	Moderate	Moderate	Moderately suited	Poorly suited	Poorly suited	161.05

E- Upland Soils – 45 to 60% slope gradient – "Soils of Concern"							
Chestnut loam, stony, 45 to 60%	ChG	Very severe	Moderate	Poorly suited	Poorly suited	Poorly suited	122.30
Cowee-Evard complex, 45 to 60%	CxG	Very severe	Moderate	Poorly suited	Poorly suited	Poorly suited	85.43
Porters loam, stony, 45 to 60%	PsG	Very severe	Moderate	Poorly suited	Poorly suited	Poorly suited	40.38
Saunook-Porters complex, 45 to 60%	SpG	Severe	Moderate	Poorly suited	Poorly suited	Poorly suited	12.68
Total acres in project activity stands							3693.94

Acres are based on proposed treatment areas in the Proposed Action, Alternative 2, and changes proposed that created Alternative 3

3. Existing Soil Conditions

Existing soil conditions within project activity treatment units were evaluated with regard to detrimental soil disturbance, soil types and interpretations for use and management. Detrimental soil disturbance (DSD) is a term developed in the past decade by entities involved in forest management concerned with soil productivity and soil quality impacts, including Forest Service research scientists and practitioners, a number of timber companies and other government agencies. Detrimental soil disturbance (DSD) is described as the condition where established threshold values for soil properties are exceeded and result in significant change to soil productivity levels (Reeves, et. al. 2011).

A primary objective in managing forest soils is to identify desired soil conditions and then evaluate impacts and disturbances that affect these conditions. The Forest Service, in soil quality monitoring protocols (USDA Forest Service 2009) has developed thresholds for compaction, displacement, rutting, severe burning, surface erosion, loss of surface organic matter, and soil mass movement. For the Cooper Creek Project, the DSD categories of compaction, rutting, displacement, and surface erosion would be the thresholds of most concern. In treatment activity areas, DSD is generally limited to skid trails, log landings, temporary roads, and dozer constructed control lines for prescribed burns where surface soil layers are excavated (displaced), and multiple passes of equipment can occur during the course of ground operations.

Soil disturbance classes (0 to 3) have been developed by the Forest Service to assess conditions and identify impacts to soil quality or productivity. Classes are generally defined by the evidence of equipment impact, level of soil disturbance and impact to soil function. Class 0 is a relatively undisturbed condition, similar to reference conditions. Class 1, 2 and 3 are progressive levels of the evidence of equipment operation and the impacts of this activity on soil function. Impacts are described in terms of visual indicators, e.g. wheel tracks, displacement of surface soil, burn severity, and compaction. Changes in soil physical condition, e.g. structure, which requires investigation below the soil surface are also indicators (USDA Forest Service 2009).

Surface erosion hazard within proposed treatment activity areas for both alternatives indicates the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface (NRCS 2014). For the Cooper Creek Project area, soil map units are rated as moderate, severe and very severe, with the variation being most closely related to the slope gradient of the mapping units. Soil mapping units with gradients of 10 to 25 percent are rated moderate, 25 to 50% rated as severe, and those with gradients exceeding 50% rated as very severe. The ratings indicate the likely occurrence of erosion, and the need for erosion control measures including revegetation of bare areas to control erosion and surface runoff. Very severe indicates that significant erosion is expected, loss of

soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

To effectively mitigate the hazard of erosion on treatment activity areas will require pre-operation planning to identify suitable access routes (skid trails, temporary roads) that can minimize erosion and sediment movement on steep slopes into riparian areas, and needed erosion control measures during and after disturbance to reduce erosion and soil loss. Up to five miles of temporary roads are proposed for Alternative 2 and 3 for the Cooper Creek project. The proposed routes are identified on existing alignments that will require reconstruction, and post-operation rehabilitation. Log landings will be required for each of the commercial timber harvest areas, approximately one landing (0.5 acres in size) per 20 acres of treatment, resulting in about 116 log landings for Alternative 2 and 84 sites for Alternative 3. Landings will need to be planned prior to construction to identify optimum locations in proximity to haul routes and away from sensitive areas such as riparian corridors or steep slopes. Most of the units proposed for harvesting have existing log landing sites from previous harvest operations that can be re-opened and used for this harvest entry. Skid trails, used by rubber-tired skidders to move felled trees to loading areas, typically represent 2 to 10% of a timber harvest area (Sawyers, Bolding, Aust and Lakel, 2012) with the potential to negatively affect site productivity and water quality if not properly located and mitigated during operations. A desirable mitigation in recent years that has proven effective to reduce overland flow and raindrop impacts is the dispersal of slash from logging back onto disturbed skid trails.

Compaction by equipment results in either a compression of the soil profile or increased resistance to penetration (USDA Forest Service 2009). Compaction in soils increases bulk density, decreases water and air movement into and through the soil, restricts root growth, and increases surface runoff and erosion (Reinhart 1964, Greacen and Sands 1980). Compaction is often the most obvious and principal form of soil impact resulting from harvest activities. The susceptibility of soil to any detrimental change is predicated on soil moisture (Froehlich 1972), soil type (Hatchell and others 1970), and organic matter content (Howard and others 1981) at the time of harvesting (Reeves et al. 2011).

For the Cooper Creek Project area, compaction or rutting hazard on soil map units are rated as moderate to severe where ruts are likely to form in the uppermost soil surface layers on moderate rated soils, and ruts readily occur on soils rated severe. Ratings assess the operation of equipment, e.g. rubber-tired vehicles, on forest sites (3-10 passes) when the soil moisture is near field capacity, typically after 0.5 inches or more of precipitation. Rutting depths are usually from 2 to 24 inches and depends, in part, on the weight of the equipment (NRCS 2013) and the soil physical properties.

Mitigation measures to minimize soil compaction on proposed treatment activity areas include pre-operation planning and design to minimize operations on soils rated moderate to severe during wet periods of the year, and stopping operations when ruts are visible and deforming soils within the use area. Log landings and temporary roads generally have a higher potential for compaction or soil rutting due to higher number of repeated passes of equipment. These areas are typically identified prior to operations for post-harvest treatments, e.g. soil ripping, effective drainage, and ground cover to mitigate compaction and begin the recovery process to a natural level productive capacity.

An important factor in reducing detrimental soil disturbance (DSD) in treatment activity areas is the skill and experience of project managers, such as timber sale layout technicians, timber sale administrators, and skilled equipment operators. Regional Soil Quality Standard 4.a mandates "*At least 85 percent of an activity area is left in a condition of acceptable potential soil productivity following land management activities*" (USDA Forest Service, 2003a). To meet this standard requires knowledge

of local conditions and areas, as well as knowledge of operation methods to keep DSD levels below the mandated 15% of areal extent in an activity area (Reeves, 2011).

3.3.2 Effects on Soils

A. Methodology

This analysis includes potential effects to soils from proposed harvest systems, construction and reconstruction of system roads, daylighting wildlife openings, temporary roads, log landings and fuel treatments.

Direct effects on soils from proposed activities were estimated by analyzing the effects of erosion, compaction, rutting, displacement, and prescribed burning on the soil surface. This is the most productive layer and also the easiest to disturb and deform through management activities. Compaction, erosion, rutting, displacement, and severe burning can affect the soil's physical, chemical and biological properties, which can indirectly affect the growth and health of trees and other plants. Compaction and rutting reduces soil permeability and infiltration, which can cause soil erosion. Erosion physically removes soil material from one area to another area. Displacement (soil excavation and movement) reduces plant growth where topsoil and organic matter are removed.

Direct and Indirect Effects

Direct effects of an action are caused by the action and occur on site and affect only the area where they occur. Indirect effects are caused by the action, occur later in time or farther removed in distance, but are still reasonably foreseeable. In general, direct and indirect effects to soils as a result of the two Action Alternatives include:

- Reduction of the forest canopy would decrease interception (precipitation captured by leaves, branches and boles) and increases net precipitation reaching the soil surface.
- Partial removal of the forest overstory reduces transpiration (water lost from plants to the atmosphere).
- Reductions in interception and transpiration increase soil moisture content, water available for plant uptake, and water yield.
- Increased soil moisture and loss of root biomass can reduce slope stability.
- Impervious surfaces (roads and trails) and altered hill slope contours (cut-slopes and fill-slopes) modify water flow paths, increase overland flow, and deliver overland flow directly to stream channels.
- Impervious native surfaces increase soil erosion.

Alternative 1 - No-Action
Direct and Indirect Effects

Alternative 1 proposes no commercial harvest treatments, non-commercial treatments, or road construction or reconstruction activities. Therefore, there would be no direct or indirect effects to the soils within the project treatment activity areas.

Prescribed burning treatments described in the proposed action alternative, however, would be available for implementation under Alternative 1. The prescribed burns have been approved under previous environmental decisions. Direct and indirect effects of prescribed burning are described in

detail under the next section in this Soils discussion. Under this alternative, prescribed burning would occur during the dormant season only.

Under the No Action Alternative, there would be no changes to the existing road system or obliteration of roads currently contributing to loss of soil productivity or degradation of water quality.

This alternative would result in no additional acres of ground or soils disturbance from mechanical vegetation treatments, construction of permanent or temporary roads. Fireline construction of approximately one mile of bladed line, and hand equipment clearing of existing lines on prescribed burns within the Cooper Creek watershed would occur for burns planned for implementation.

Cumulative Effects

Additional effects to soils would not be expected to occur within the proposed activity treatment stands as no proposed vegetation treatment actions would be implemented. With no new activities, no new management caused detrimental cumulative impacts would be expected within the project area.

Direct and Indirect Effects to Soil Resources Common to the Action Alternatives

Potential effects of Alternatives 2 and 3 on soil productivity would include compaction, rutting, displacement, erosion, loss of soil organic matter, short-term changes in soil moisture content and changes in nutrient cycles. Introduction of invasive weeds can also be detrimental to native plant growth on soils. These effects could result from mechanical and non-mechanical vegetation treatments (i.e. thinning), fireline construction and clearing, implementation of prescribed fire, and road construction, maintenance, and decommission activities. Mechanical vegetation treatments have the potential to adversely affect soil productivity through erosion, compaction, rutting, and causing sedimentation from off-site soil movement to stream courses. Well-designed and effective implementation of Best Management Practices (BMPs) during, and post-operation would minimize adverse impacts to soils and water quality.

Soil compaction, rutting, and displacement would be primarily limited to the equipment access routes and high traffic areas within mechanical vegetation treatments, including existing Forest Service system roads, temporary access roads to harvest units, skid trails and log landings. Periods of operation "shut-down" for roads and mechanical vegetation treatments during wet weather, and designation of authorized access routes (skid trails and temporary roads) and log landing sites within the project treatment areas prior to project implementation would minimize adverse effects to soil productivity caused by these activities. With implementation of applicable BMPs as outlined in Table 2.16 – Design Features and Mitigation Measures for Action Alternatives, most adverse effects to soils would be minimized, mitigated or treated to begin restoration to desired conditions.

The risk of short-term accelerated soil erosion would be expected to increase in areas where forest thinning and use of prescribed fire results in soil disturbance or complete removal of vegetation ground cover. These areas are expected to include skid trails, log landings, temporary access roads, decommissioned roads, constructed firelines and prescribed fire treatments, and Forest Service system roads. Timber harvest areas have been identified and designed to maximize operational feasibility of mechanical treatments. Slope steepness, proximity to streams and riparian corridors, and overall terrain shape guide the type of harvesting operation and equipment to be used with each area. The proposed treatment areas for the Action Alternatives will be harvested using ground-based systems; e.g. felling machines, skidders, delimbing gates, log loaders, and log transport trucks.

The removal of forest cover can decrease raindrop interception and evapotranspiration, which can increase water yields from treated areas (Bosch and Hewlett 1982, Stednick 1996). Thinning of forest cover would improve soil conditions over the long-term by improving soil moisture and allowing greater sunlight penetration to the forest floor resulting in an increase in grasses, forbs, and shrubs in the forest understory. The increased herbaceous vegetation would reduce soil erosion rates by providing vegetation and litter ground cover that would intercept rain before it can reach soil surfaces and detach and entrain soil particles in runoff water. Woody debris from forest thinning (i.e. slash, tops, branches) would be lopped and scattered on skid trails, log landings and temporary roads after operations end to provide ground cover and erosion control, further reducing potential adverse effects to soils.

Effects of Prescribed Fire on Soils, Nutrients and Repeated Use of Fire

Soils are fundamental to a healthy and functioning ecosystem. Effects on soils by fire, and the level of impact a fire has on an ecosystem are largely determined by how severely a fire burns. (Erickson, 2008) Fire severity reflects the duration and amount of energy that is released and available to alter various components of an ecosystem, whereas soil burn severity reflects the impact of fire on soils due to heat at the soil surface.

Prescribed burning is proposed on nine (9) burning units within the Cooper Creek watershed, for a total of 11,842 acres (average burn size, 1315 acres). Prescribed burning would use hand and/or aerial ignition with an objective of a mosaic burn pattern across the landscape. High to moderate intensities are desired for south and west facing xeric ridges and upper sideslopes, moderate intensity on midslopes and low intensity backing fires in riparian areas and mesic hardwood stands. After initial burn treatments, a 3 to 5 year rotation prescribed fire sequence is proposed. Plans for burning indicate no more than 2 to 3 burning units would be implemented within any given calendar year, equating to each unit being burned 2 to 3 times over a 10-year project life cycle, or approximately 2,000 to 4,000 acres burned annually. Approximately 1 mile of bladed control line would be required for the identified burn units. The remainder of control lines are existing roads, creeks or control lines cleared with hand blowers to remove fuels. A table in Chapter 2 of this EA displays the specifics of each prescribed burn in the Cooper Creek Project. The goal of this prescribed burning is to restore fire dependent/fire-adapted vegetation communities.

Phosphorus has been suggested as a mineral lost due to fire events. Phosphorus is indeed an important element to plant growth, and is known to be deficient in some soils, particularly the deep sands found in the southeastern coastal plains. Knoepp et al (2005) identified phosphorus as probably the second most limited nutrient found in natural ecosystems, with nitrogen being the most limiting. Soils of the Chattahoochee are not identified as "phosphorus deficient." Phosphorus is volatilized at higher temperatures (774^{o}C +) during soil heating than nitrogen (300-500^{o}). The combustion of organic matter leaves a relatively large amount of highly available P in the surface ash found on the soil surface immediately following fire, remaining available for plant growth.

Responses of available soil P to burning are variable and more difficult to predict than those of other nutrients (Raison and others 1990). Phosphorus volatilizes at temperatures of about 1,418 ^{o}F. Heat sensitive paint and chalk on tiles (suspended 30cm above forest floor) have been used in several southern Appalachian studies to characterize the temperature of prescribed burns. Mean temperatures ranged from 529 – 1470^{o}F for summer burns, and 126 – 1292^{o}F for late winter burns. Higher temperatures would be expected in situations where large fuels (log piles) smoldered for extended periods of time creating thick piles of ash. Fire severity affects changes in extractable P, losing 50 to

60 percent of the total fuel P to volatilization. Part of this volatilized P ends up as increased available P in both the soil and ash following burning.

Many chemical properties and processes occurring in soils depend upon the presence of organic matter. Soil organic matter is particularly important for nutrient supply, cation exchange capacity, and water retention. Burning, however, consumes aboveground organic material (future organic matter, including large logs), and soil heating can consume soil organic matter. The importance of retaining organic matter to soils is included in objectives of prescribed fire prescriptions by identifying desired burning conditions that consume above ground fuels in low intensity burning, with low severity. The desired result is to burn the L-layer or Oi layer which is made up of readily identifiable plant materials. In layperson terms this is the "litter" layer. Beneath this layer is the F-layer or the Oe horizon which contains partially decomposed organic matter, but can still be identified as different plant parts, a "duff layer." The H-layer (Oa) is the humus layer of completely decayed and disintegrated organic materials, some of which are usually mixed with the upper mineral soil layers (Knoepp et al. 2005). Mineral soil begins beneath these layers of fresh and/or decomposing plant materials.

Elliott (2002) described the effects of a prescribed burn treatment in western North Carolina, conducted to restore a pine-hardwood ecosystem. The study assessed fire severity by measuring heat penetration of the burn into the forest floor and mineral soil. Results revealed that little consumption of the Oe + Oa layer occurred during burning, while the litter layer (Oi) was consumed as high as 94%. This maintenance of the Oe + Oa layers is critical for site nutrient retention (nitrogen and carbon) and soil stabilization. Burning to keep Oe + Oa layers intact provides protection to the soil surface from erosion loss. This desired condition meets the direction of Forest Plan standard FW-202 (page 2-55 Forest Plan); "*Prescribed burning, other than slash burns, will be designed to retain litter and/or duff material on at least 85 percent of the project area, excluding fire lines."*

Fire managers cannot control fire weather but they can control ignition timing and type, and consequently fire intensity (Clinton 2007). Under all site conditions, the longer a prescribed fire persists in one place the more intense the fire and the more likely there will be significant consumption of the humus layer. Minimizing consumption of the humus layer has important implications for long-term site productivity, as this layer is typically the largest reservoir of available site nutrients in these ecosystems. This retention of humus is particularly important during the post-burn recovery period when young woody and herbaceous seedlings are becoming established (Clinton and Vose, 2000). Prescribed burning can enhance overall site quality and productivity over the long-term by stimulating nitrogen cycling processes.

Knoepp (2005) provides a summary of the effects of prescribed burning on organic matter: "The most basic soil chemical property affected by soil heating during fires is organic matter. Soil organic matter plays a key role in nutrient cycling, cation exchange, and water retention in soils. When organic matter is combusted, the stored nutrients are either volatilized or are changed into highly available forms that can be taken up readily by microbial organisms and vegetation. The amount of change in organic matter and nitrogen is directly related to the magnitude of soil heating and the severity of the fire. High- and moderate-severity fires cause the greatest losses."

Installation of dozer-constructed fire control lines where they do not currently exist would expose soil surfaces to establish a break between fuel types, increasing the risk of surface erosion from rain and overland flow. Rehabilitation of fire control lines installed during prescribed burning would minimize adverse impacts to soil productivity (erosion) from fire control lines. Prescribed burn areas are designed to utilize existing roads, stream channels or other existing control features where possible to minimize the amount of dozer constructed lines needed.

Soil organic matter serves as the long-term nutrient supply for all vegetation occupying a site. It also provides microhabitat for most soil organisms and improves soil chemical and physical properties including soil aggregate stability, increased porosity, improve water holding capacity, lower bulk densities, and nutrient cycling. Initially, there would be an expected short-term increase in soil organic matter as a result of mechanical vegetation treatments as woody debris is deposited on soil surfaces during treatments. Forest thinning would also allow greater light penetration to soil surfaces resulting in warmer soil temperatures. The reduction in tree vegetative cover as a result of forest thinning would decrease evapotranspiration rates and therefore increase soil moisture. Warmer soil temperatures and greater soil moisture content would result in increased soil biological activity. Increased soil biological activity results in a proportional decrease in soil organic matter as organisms consume soil detritus. The eventual increase in understory vegetation would result in increased litterfall and deposition of organic matter onto soil surfaces. Broadcast fire during prescribed burning would result in rapid oxidation of surface organic matter and living understory biomass, causing a release or transformation of some soil nutrients.

Effects of Roads

Runoff from road surfaces can detach and transport the fine material (soil particles) from road prisms and ditches, particularly during storm events. Sediment delivery directly from road surfaces to water courses is difficult to estimate since it occurs as non-point runoff. Sediments delivered to streams from roadside ditches may have originated from sheet or rill erosion in upland areas prior to entering road surfaces or ditches. In the absence of vehicle use, sediment concentrations in road runoff typically decrease over time. Road location and connectivity to streams in the area can strongly influence sediment delivery to streams and peak flows in streams. Roads within the project area intersect numerous streams, of all types. These points of intersection occur as both culvert crossings and road segments adjacent to stream channels. These points are the primary location where sediments are delivered to stream courses.

Both Action alternatives identify changes to operation status for a number of Forest Service system roads. Changes identified include either year round or seasonal closure to vehicles to reduce road management costs and use, and impacts to resources. Seasonal closure of 21.6 miles of road segments in both alternatives and year round closure of 6.7 (Alternative 2) to 9.1 miles (Alternative 3) to vehicle use year round would allow road prisms to stabilize and slowly return soils to a level of natural productivity over a period of time. An additional 2.7 miles of system roads will be decommissioned in Alternative 3. Reduced erosion and sediment will have a direct positive benefit to watershed condition for soils and streams.

There will likely be some short-term, localized impacts to watersheds from the Action alternatives in the form of increased runoff from treatment areas, increased sediment delivery to ephemeral drains, and increased turbidity in surface water, long-term direct and indirect effects to watershed condition would be improved in soil and watershed function due to greater ground cover of grasses, forbs, and shrubs which would improve overall soil stability, water holding capacity, increase sediment capture in surface runoff, and minimize overland flow to roadways and roadside ditches. Since treatment activities will be time sequenced (i.e. not occurring at the same time, but implemented over a period of time), the likelihood of large-scale soil erosion or sediment delivery to streams is minimal.

Effects of Herbicide Treatment for Site Preparation and Release

Application of herbicide is proposed using triclopyr herbicide for connected site preparation, release and midstory control treatments in certain restoration and maintenance treatment areas. A total of 3251 acres of herbicide treatment is identified in the Proposed Action. Herbicide treatment acres are to be reduced to 1327 acres under Alternative 3, primarily dropping treatments from stands proposed for oak/oak-pine thinning, pine/pine-oak thinning, or release.

The herbicide, Triclopyr (Garlon 4 or equivalent), is applied directly to the stem or cut stump of targeted woody species. This application is described in more detail in the proposed action in Chapter 2, and in Appendix F – Herbicide Risk Assessment. Triclopyr is a selective systemic herbicide used to control woody plants, and has a soil half-life of 30 days. Triclopyr is potentially mobile in soils since it is generally not bound to soil particles, but in general there is minimal movement through soil. Cut surface treatments are precise allowing little chance of misapplications. Applications are not in proximity of riparian areas or streams.

Herbicide treatment methods are targeted to be applied using cut-stump, injection or foliar applications, primarily to reduce competition of undesirable species prior to planting seedlings, and releasing desired seedlings from competition to be free to grow. Herbicide application direction is described in the proposed action in Chapter 2. This treatment would have minimal effect on soils using a selective hand-applied foliar spray method. This application is targeted to the leaf surface or the stem for maximum effect. No soil disturbance would occur. The average half-life of triclopyr in soils is about 30 days. Triclopyr is potentially mobile in soils since it is generally not bound to soil particles, but in general there is minimal movement through soil.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Commercial Vegetation Management Treatments

The Proposed Action will use ground based logging system to treat 2,315 acres for oak/oak-pine thinning, pine/pine-oak thinning, canopy gap thinning, regeneration for early successional forest habitat and creation of woodland habitat. During these treatments, the potential for creation of detrimental soil disturbance would exist with the construction of log landings, skid trails, and temporary roads for truck access. Direct effects include compaction, erosion and displacement.

Table 3.3.5 displays the estimated acres of soil disturbance based on the proposed ground disturbing activities in the project alternatives. The primary causes of ground disturbance will be the creation and use of log landing and loading areas in the commercial treatment stands, the associated skid trails in the stands to move felled logs from stump to landing and the temporary roads used by trucks to transport logs from the treatment stands to the main permanent system roads. Soil disturbance will result from excavation with equipment to create lands and temporary roads, and multiple passes by skidders through the stands to collect felled trees. These disturbances and the resulting effects are described in more detail following the table.

Table 3.3.5 Estimated Acres of Soil Disturbance for Alternative 2 and 3

Treatment Activity	Alt. 2	Alt. 3	Assumptions used to determine area of disturbance	Alt. 2	Alt. 3	Pct. of Project Area [1]
	No. of sites or miles		Assumptions for area extent of ground disturbance	Acres of soil impacted		

Log Landing & Loading Areas	116 sites	84 sites	0.5 acre per landing, estimate of one landing per 20 acres of harvest unit	58	42	1 to 2
Skid Trails	n/a	n/a	Skid trails not bladed, trees removed from trail, 3-6 passes by harvest equipment, 2 to 10% of harvest area – use average of 5%	115	84	2-3
Temporary Roads	5.0 miles	5.0 miles	20 foot wide bladed travel surface and shoulders – 2.4 acres per mile disturbed	12	12	<1
Bladed Fire Control Line [1]	1.0 mile	1.0 mile	6 to 8 foot wide line created by dozer blade, approximately 1.0 acre per mile disturbed	1	1	< 1
System Road Reconstruction	2.8 miles	3.0 miles	20 foot wide travel surface, 6 foot wide shoulders, reduce area of disturbance by 50% of construction, 2.4 acres per mile disturbed	6.7	7.2	<1
			Total acres of potential detrimental Soil impact	193	146	4-5%

[1] Prescribed fire acres are not included in the percent project area calculation. One mile of bladed line will be utilized, remainder of control lines are streams, open roads and trails.

Log landings used for ground based harvest units are located near existing Forest Service system roads where suitable sites can be identified, or along temporary roads a short distance from permanent roads if needed. Landings are developed a minimum of 100 feet from stream channels and riparian corridors to provide adequate buffer distance between ground disturbance and streams. Landings are typically cleared of vegetation and maintained as openings during operation periods, with periodic clearing to maintain proper drainage for overland flow, and dry soils during use periods. Landings generally are subjected to compaction during the equipment use periods. These effects can last for decades but can be mitigated with soil ripping and rehabilitation of ground cover to minimize rainfall impacts and possible erosion.

Soil erosion can result from equipment use and soil exposure in harvest treatments, primarily along skid trails with repeated equipment passes. The amount of erosion is related to the percentage of bare soil and the amount of surface soil disturbance, and these two factors are typically proportional to the number of trees being harvested (Haupt and Kidd 1965). In general, soil erosion rates are within acceptable limits (low) when the proportion of bare soil is less than 30 percent (Robichaud 2010, Swank et al 1989).

Skidding with rubber-tired skidders generally requires a network of routes from the harvesting area to the log landing for processing. Studies have shown that ground-based systems have the highest level of ground disturbance when compared to systems that operate overhead with minimal ground contact of the logs. The amount of skidding and associated soil disturbance depends on site-specific characteristics, timing of operations, type of equipment, and the percentage of a particular stand being thinned. Generally, the steeper the slope gradient, the higher the potential for soil disturbance to operate ground based systems. Erosion along disturbed areas (skid trails) would be expected to deliver sediment off-site for short periods until operations cease and soils are stabilized with ground cover to mitigate erosion. The stands proposed for vegetation treatment activities and prescribed burning currently have dense overstory conditions, shrubs on a moderate percentage with ground cover composed of intact, thick duff and root mats, and some herbaceous vegetation, depending on the amount of canopy opening. These stands have not undergone any vegetation treatments in the past 30 plus years. Thinning treatments will open the canopy and create a structure that will encourage more light to the ground with an increase in herbs, forbs and grasses, providing desirable ground cover and soil protection.

Non-Commercial Vegetation Management Treatments

The Proposed Action will treat several identified stands by non-commercial thinning, primarily using chainsaws to cut and leave trees and/or herbicide treatment. Approximately 1,439 acres of stands are proposed for thinning, creation of canopy gaps, and midstory treatment, intended to allow sunlight to the forest floor to stimulate new and existing oak regeneration. During these treatments, the potential for creation of detrimental soil disturbance would be minimal due to no use of existing ground-based harvest systems, or development of access routes for equipment.

Permanent and Temporary Roads

Construction, reconstruction and maintenance activities related to roads represent the greatest risk source of accelerated erosion throughout the project area due to the amount of soil exposure, active erosion, and potential sediment delivery to streams. The origin of the oldest permanent roads in the project area dates to the 1930s or earlier. This generation of roads are typically not located or constructed to current modern Best Management Practices or engineering standards. Mulky Road, FS 4, is an example of this situation with the evidence being its location along perennial Mulky Creek or its tributaries. Several other roads in the project area, such as FS 33 Cooper Creek Road, FS 39 Duncan Ridge Road, FS 261 Burnett Creek, and FS 4D Spenser Mountain, were constructed and/or reconstructed by the Forest Service since 1970 and built to more modern engineering templates that address impacts to soil and water. Best Management Practices such as broad-based dips, lead-out ditches, aggregate surfacing on road surfaces, and maintaining road conditions to BMP standards, have been installed on these roads to mitigate impacts. These practices have been shown to be effective at mitigating erosion from road surfaces and protecting water quality (Burroughs and King 1989).

These acres in road prisms (driving surface and shoulders) would be considered out of the productive soil base available for growing vegetation as the roadway and shoulder slopes are compacted, excavated, or otherwise changed from a natural productivity condition.

Cumulative Effects of Alternative 2

Cumulative effects include the combination of direct and indirect effects from past, present, and reasonably foreseeable future activities added to the direct and indirect effects of the proposed activities. Since direct and indirect effects on soils are measured within the activity areas, the cumulative effects analysis area for the soil resource consists of the cumulative impacts within each of the activity areas.

As previously discussed, the soils evaluation differs from most other resource evaluations because it is limited to the unit boundaries in most cases. Several other resources are evaluated on a larger cumulative effects area. Because of this, there are many present and reasonably foreseeable activities that are not considered for the soils cumulative effects analysis because they do not occur within unit boundaries.

The cumulative result of Alternative 2, combining proposed timber activities, road construction and reconstruction, prescribed burning, and wildlife opening daylighting, is that full productivity of soils would be retained on the acres treated under the Regional standards and Forest Plan standards, with some potential for detrimental effects on the soils disturbed for equipment access and operation. Under Alternative 2 – Proposed Action, and Alternative 3, all proposed treatment activity sites are expected to meet Regional and Forest Plan requirements after harvest, road construction and reconstruction, prescribed burning, and wildlife opening daylighting actions are concluded.

Timber Harvest – In the reasonably foreseeable future (5 to 10 years), no additional timber activities within the Cooper Creek project are proposed or ongoing. Most of the proposed units for Alternatives 2 and 3 have had prior entries, and the effects of a secondary entry do not necessarily add to effects of the earlier harvests because existing landings and temporary roads would be used again (if compliant with Best Management Practices and Forest Plan standards).

Alternative 3

Direct and Indirect Effects

The original proposed action presented to the public received a number of responses that were fully evaluated, resulting in additional field evaluations and investigations to consider changes to the proposed action. Several factors were identified to evaluate proposed action changes. A thorough description of the modifications can be found in Chapter 2.2.3 of this EA.

Reductions in ground disturbance in the project area for commercial timber harvest were the primary modification, with a change to either non-commercial treatments to achieve the objective, or a complete deletion of the stand to be treated. Overall the modifications reduced the harvest treatments from 3754 acres to 2591 acres, a change of 1163 acres. Acres of herbicide treatments also declined from 3251 acres to 1327 acres. The proposed prescribed burning acreage remains the same in both action alternatives.

The direct and indirect effects of Alternative 3 are basically the same as described for Alternative 2, but reduced in area proportionately by the decrease in stands to be treated. These reductions are reflected in Table 3.3.5, Estimated Acres of Soil Disturbance for Alternative 2 and 3, which displays the acres of soil impacted and the percentage of the project area. One factor used in the review of stands for Alternative 3 was the slope steepness and the feasibility of using ground based equipment during operations, resulting in several stands being dropped from consideration.

Cumulative Effects of Alternative 3

The cumulative effects for Alternative 3 are basically the same as described for Alternative, but again reduced in area proportionately by the decrease in stands to be treated.

Under Alternative 3 all proposed treatment activity sites are expected to meet Regional and Forest Plan requirements after harvest, road construction and reconstruction, prescribed burning, and wildlife opening daylighting actions are concluded.

Regulatory Consistency

Forest Plan

The proposed activities would comply with Forest Plan standards for maintaining soil productivity. All alternatives would comply with Forest Plan Standard # FW-065 as all proposed activity areas would be at or below soil quality limits for disturbance and would maintain the acceptable productivity potential for managed vegetation. The proposed activities have the potential to disturb approximately 193 acres with Alternative 2; and 146 acres for Alternative 3. Proposed activities would result in detrimental soil disturbance on less than 10 percent of the activity areas following activities and mitigations, below the standard in the Forest Plan.

Region 8 Soil Quality Standards

All alternatives would comply with Region 8 soil quality standards, with units expected to be at or below the standard of 15 percent detrimental soil disturbance after mitigation.

Summary of Effects

Alternative 1 – No-Action

The effects to the soil resources of Alternative 1 (No-Action) would be a mix of both positive and negative. With no management actions, there would be no additional soil disturbance from management activities. Any previously disturbed soils would continue to slowly recover. Wildfire damage to soils could occur depending on the severity of the wildfire. Severely burned soils could be devoid of ground cover and subject to overland flow, erosion, and infestation of invasive weeds.

Alternative 2 and 3

The effects of both action alternatives would address the purpose and need for the project. Differences would occur in the number of acres to be treated, with Alternative 2 treating more acres than Alternative 3, but with the additional impacts to the soil resources. Soil disturbance would be reduced with the implementation of Alternative 3 due to fewer acres of vegetation management, with fewer acres disturbed for activities. When design features (including Best Management Practices, timber sale contract provisions, and other project mitigations) are implemented, both alternatives are expected to accomplish the goals of the Cooper Creek Project identified in the purpose and need and be in compliance with the Chattahoochee-Oconee Forest Land Management Plan.

Soils- Base Cations

Affected Environment

Base cations are essential to support heathy ecosystems. The base cations include calcium, magnesium, potassium, and sodium. In addition, calcium, magnesium, and potassium are nutrient cations because they support the growth and maintenance of healthy vegetation. For example, the trunks of trees contain a large amount of calcium in the wood. Precipitation percolates through the soils, flows downslope, and carries a portion of the soil base cations into a stream (Tomlinson 1990). Brook trout use calcium for their bone development, while aquatic insects use calcium for their exoskeleton.

Additions of base cations to the soils occur from dust outside of the watershed, or from the weathering of rocks inside the watershed. The weathering of rocks is the primary source of new supplies of base cations. These positively charged cations attached to the negatively charged soil organic matter or soil colloids. Thus, they are stored in the soil and biota can utilize them later (Tomlinson 1990). The base cations taken up by the trees and other organisms return to the soil. In the late 1800s and early 1900s, widespread timber harvesting, disrupted this nutrient cycling by removing base cations from the ecosystem in the watersheds. In addition, some locations lost base cations following severe soil erosion.

The industrial revolution began the rapid consumption of fossil fuel use to meet the United States increasing energy demands, and their consumption continues today. The burning of fossil fuels releases sulfur dioxide and nitrogen oxides into the atmosphere. Transport of these gases downwind allows them to convert into strong acids of sulfates and nitrates. Ammonia released from agriculture activities is another source of acidity. Eventually, deposition of these acid compounds occurs on the National

Forest, with the highest concentrations near the mountain ridges. Most of the acid deposition on the Forest originated as emissions released outside of the Chattahoochee Forest proclamation boundary.

Historically, sulfate deposition has caused most of the soil and stream acidification. Nitrogen is typically a lacking nutrient in most actively growing forests. Therefore, forest vegetation is using the nitrogen found in the nitrates and ammonia (Sullivan et al. 2011). To support growth, vegetation needs small quantities of sulfur (Tomlinson 1990), but the historical sulfate deposition has exceeded the needs of the ecosystem.

Sulfate deposition, typically occurs as sulfuric acid (H_2SO_4). The molecule separates into two hydrogen ions (H^+) and a sulfate molecule (SO_4^-). The hydrogen ion has a stronger affinity and replaces base cations from the soil colloids. As the hydrogen ion concentration of the soils increases then the pH decreases. If the soil pH decreases below 4.5 then soil bound aluminum is released. Similar to the hydrogen ions, the aluminum will also display base cations from the soil colloids. Soils become more acidic as the hydrogen ion and aluminum concentrations increases. Once released from the soil colloids then both hydrogen ion and aluminum can be toxic to vegetation and aquatic biota (Tomlinson 1990) .

There are two possible fates for the sulfate molecules. First, the sulfates may flow into the soil solution. The sulfates have a negative charge to the molecule. Therefore, to maintain an electrochemical equilibrium the sulfates will attached to positively charged base cations. Eventually, the base cations percolate through the soil to be removed from the watershed.

There is a second fate for sulfates deposited on the forest. In Southern Appalachia, the soils contain aluminum and iron oxides that a portion of the sulfates will attach. This is called sulfate adsorption. If the soil can no longer hold additional sulfates then they will move into soil solution. In addition, sulfate desorption begins following a decrease in sulfate deposition. For both of these situations the base cations will attached to the sulfates and removed from the watershed (Sullivan 2011).

In summary, vegetation and other biota need base cations to survive. In addition, the transport of some base cations to the streams is natural. Brook trout and other aquatic biota use base cations to support their growth. However, previous timber harvesting as well as previous and current acid deposition has accelerated the loss of base cations from watersheds. Therefore, some watersheds today may have low base cation supplies in the soils or streams. Therefore, without adequate base cation stored in the soil then additional timber harvesting could be harmful to the ecosystem.

3.3.2 Effects on Soil Resources

Measure: Calculated stream acid neutralizing capacity (ANC) using a simple mass balance model within the Ecosystem Management Decision Support System (Reynolds et al., 2012). The units of measure are micro-equivalents per liter (ueq/L).

***Bounds of Analysis*:** The watershed catchments (n = 28) that are proposed for treatment in Alternatives 3 and/or 2. These catchments range in size between 103 and 956 acres, with a mean of 365 acres (Figure 3.3.1).

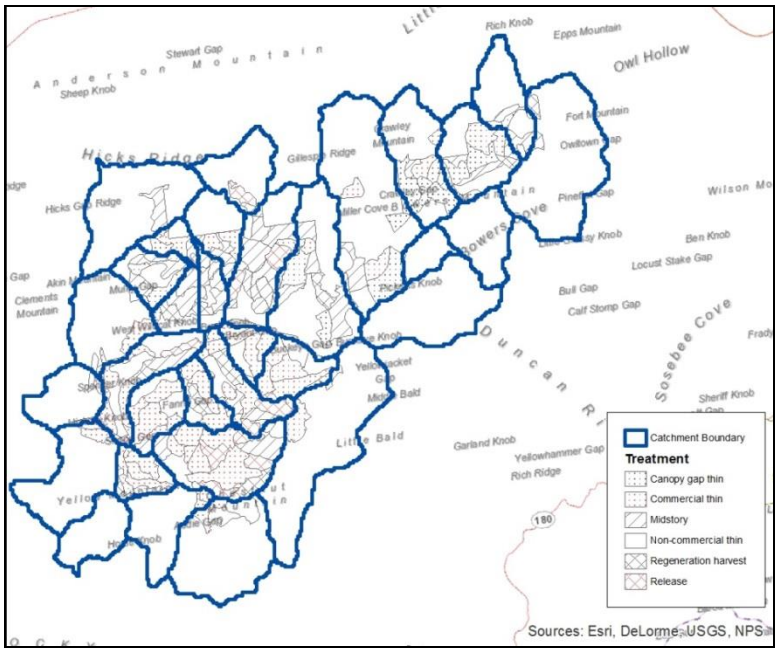

Figure 3.3.1 Boundary for this analysis and treatment proposed for each catchment.

Alternative 1: No Action

Direct and Indirect Effects

In this alternative, there would be no nutrient base cations (calcium, magnesium, and potassium) removed by timber harvesting. Base cations deposited from the atmosphere and weathering will exceed the amount removed by acidification if total sulfur deposition remains similar or lower than the mean for 2009 – 2011.

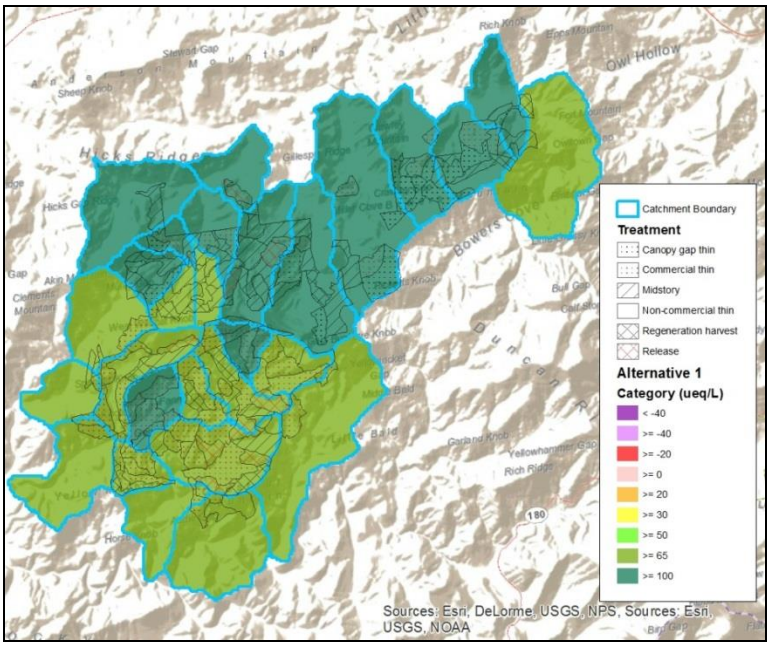

Figure 3.3.2 . Results for the No Action Alternative. Polygons show the locations of proposed vegetation management treatments for Alternatives 3 and/or 2. The calculated stream acid neutralizing capacity assumes the mean total sulfur deposition will remains the same as the mean for 2009-2011.

Cumulative Effects

None

Alternative 2: Proposed Action

Direct and Indirect Effects

Soils base cation concentrations will remain the same as the no action alternative if the boles (trunks) remain on site. Harvesting the trees and removing them from the site will reduce soil base cations from the catchment. Removal of boles in individual treatment areas has the potential to decrease the stream ANC one category, i.e. from 100 to 65 ueq/L, or in 2 treatment areas from 65 to 50 ueq/L (Figure 3.3.3). The decrease in stream ANC is likely to occur only when harvesting 45% or more of the catchment. In addition, removal of boles will reduce soil base cations concentrations. Eventually, replacement of base cations will occur by the base cations deposited from the atmosphere (annually a very small amount) and weathering of the rocks in the soil. The weathering and release of base cations is an extremely slow process and recovery could take decades.

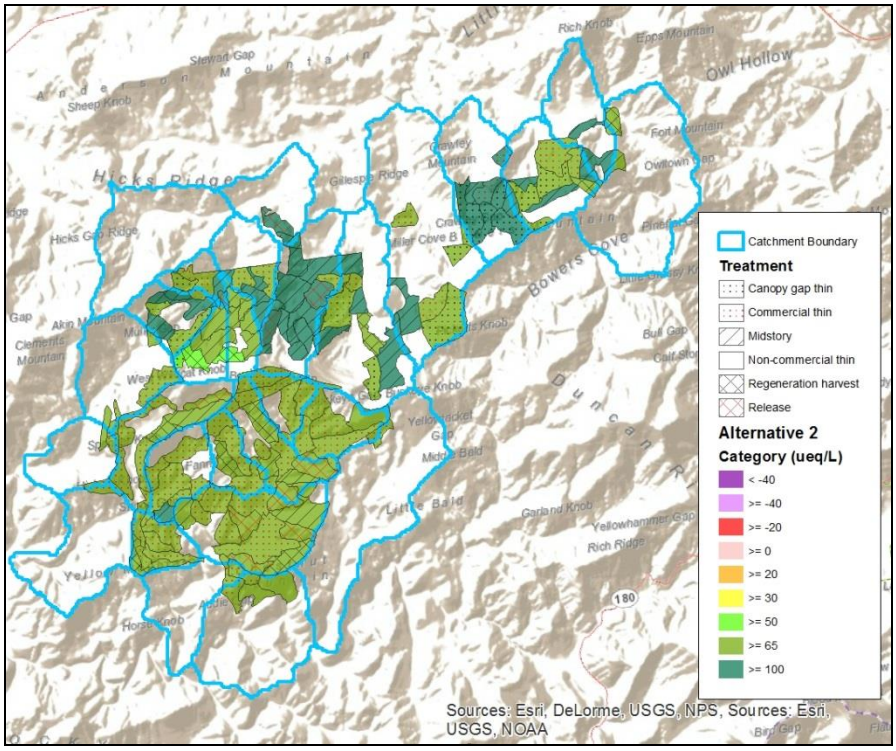

Figure 3.3.3. Results for the No Action Alternative. Polygons show the locations of proposed vegetation management treatments for Alternatives 3 and/or 2. The calculated stream acid neutralizing capacity assumes the mean total sulfur deposition will remains the same as the mean for 2009-2011.

Cumulative Effects

Figure 3.3.4 shows the cumulative effect for Alternative 2. Only two catchments will have 45% or more of the area harvested. Therefore, the stream ANC could decrease one category from 100 ueq/L to 65 ueq/L. Even with the reduction, brook trout are anticipated to be healthy and have reproducing populations because the ANC is likely to be 50 ueq/L or greater. However, there could be a decrease in the aquatic species more sensitive to acidification than brook trout.

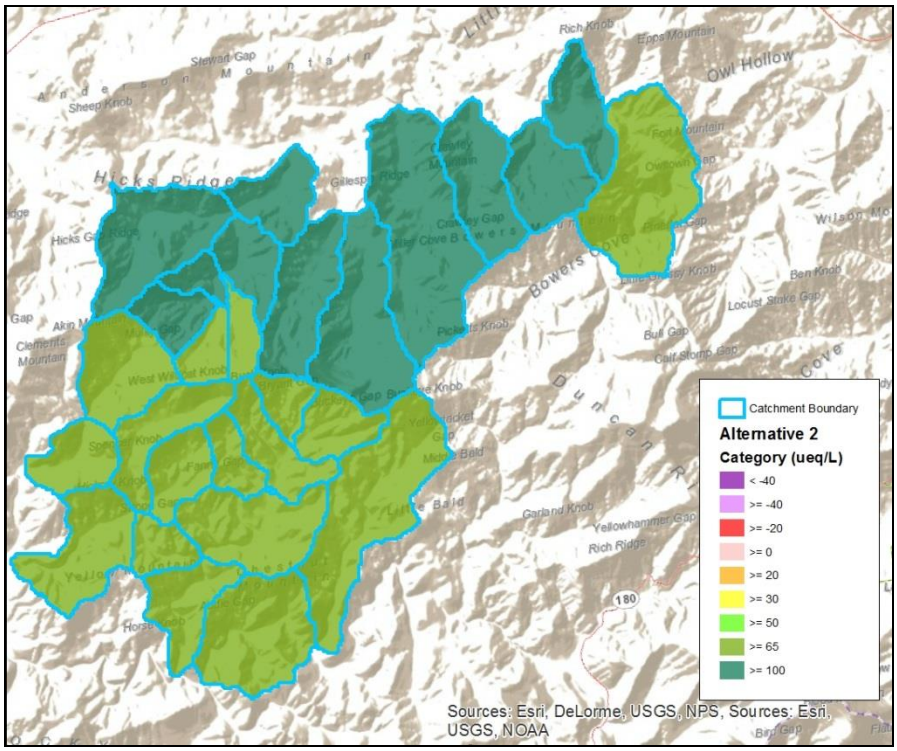

Figure 3.3.4. Cumulative analysis results for Alternative 2.

Alternative 3

Direct and Indirect Effects

The number of acres treated with timber harvesting is less than Alternative 2. Removal of boles in individual treatment areas has the potential to decrease the stream ANC one category from 100 to 65 ueq/L (Figure 3.3.5). The stream ANC decrease is likely to occur only when harvesting 45% or more of the catchment. In addition, removal of boles will reduce soil base cation concentrations. Eventually, replacement of base cations will occur by the base cations deposited from the atmosphere (annually a very small amount) and weathering of the rocks in the soil. The weathering and release of base cations is an extremely slow process and recovery could take decades.

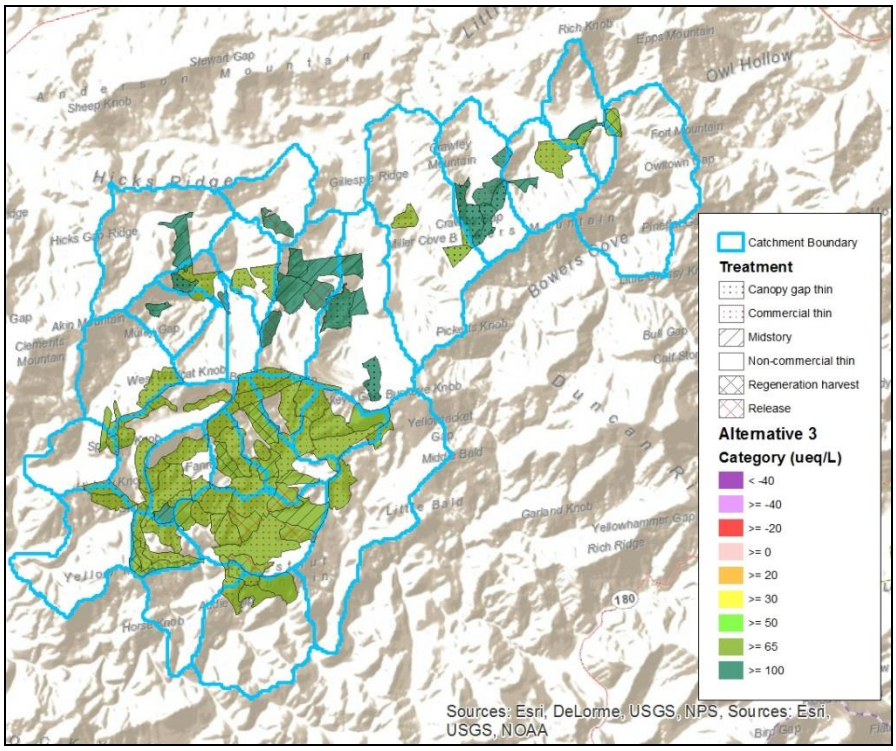

Figure 3.3.5. Alternative 3 results. Polygons show the locations of proposed vegetation management treatments. The calculated stream acid neutralizing capacity assumes the total sulfur deposition will remains the same as the mean for 2009-2011.

Cumulative Effects

Figure 3.3.6 shows the cumulative effect for Alternative 3. The amount of timber removed will be different then Alternative 2. However, the same two catchments, as Alternative 2, will have 45% or more of the catchment harvested. Therefore, the stream ANC could decrease one category, from 100 ueq/L to 65 ueq/L. Even with the reduction, brook trout are anticipated to be healthy and have reproducing populations because the ANC is likely to be 50 ueq/L or greater. However, there could be a decrease in the aquatic species more sensitive to acidification than brook trout.

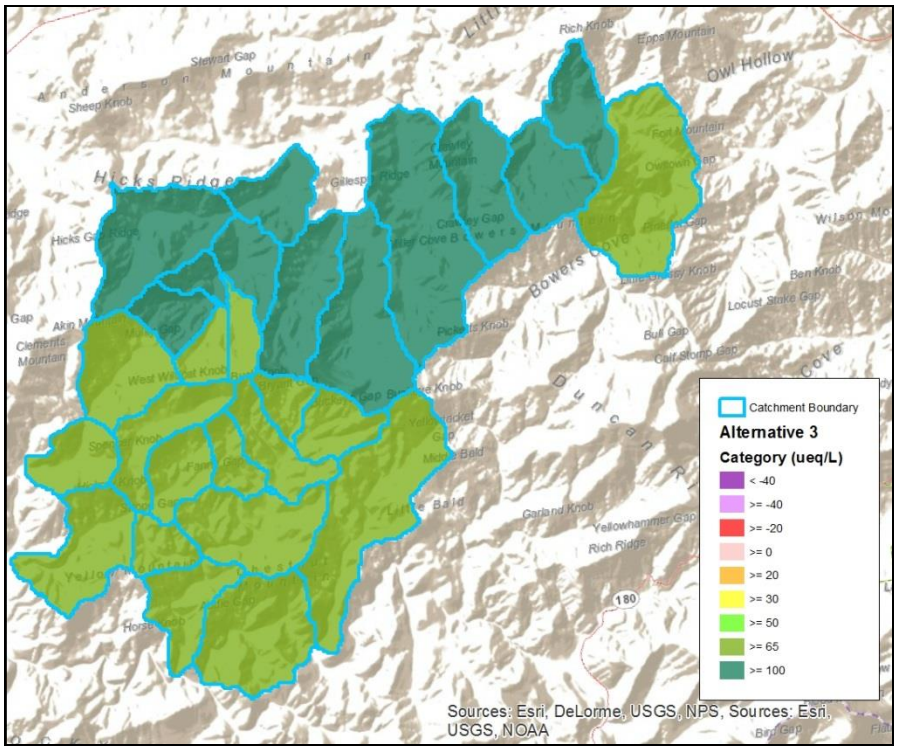

Figure 3.3.6. Cumulative analysis results for Alternative 3.

3.4 Water

3.4.1 Affected Environment

This section discusses hydrologic resources of the Cooper Creek Watershed Project. The section describes water resources in the project area, provides an assessment of current conditions, and analyzes the potential effects that treatments under the proposed action might have on water resources.

Watersheds in the United States were delineated by the U.S. Geological Survey (USGS) using a national standard hierarchical system based on surface hydrologic features. Unlike a classic watershed, a hydrologic unit may have multiple outlet points. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on six hierarchical levels of classification (Region, Subregion, Basin, Subbasin, Watershed, Subwatershed). This analysis focuses primarily on the sixth-level or sixth-field HUCs and the streams within those units. In this water resource analysis, watershed is used synonymously with HUC. The project area is within the Tennessee Region, one of the geographically smallest HUC regions in the United States.

Project Area Description

The project area is defined as the boundary of the area proposed for treatment. The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action "(50 CFR 402 subpart A). For the purposes of the water resource analysis, the action area is contained within portions of three 6th-field watersheds.

The Cooper Creek Watershed Restoration project is located in the Southern Appalachian Mountains in northeast Georgia, in the Blue Ridge Mountain chain. The underlying geology is predominantly mica schist, gneiss and granite. The project area is south of the glacial extent. Consequently, the bedrock and soils are some of the oldest in the Appalachian Mountains. The bedrock is considered relatively non-reactive and the soils are highly weathered and considered base-poor. The Piedmont and Blue Ridge crystalline-rock aquifers lie beneath the surface. The area is dominated by moderately steep hillslopes with cold water mountain streams at their base. Numerous springs and seeps are present throughout the area, but few meadows and wetlands exist except along stream corridors.

The largest of the project watersheds is Cooper Creek and is 93% national forest (Table 4.3.1). Cooper Creek watershed drains west into the Toccoa River. The Toccoa River is renamed the Ocoee River where it flows north into Tennessee. Coosa Creek and Youngcane Creek watersheds drain north to the Nottely River. Both the Nottely River and Ocoee (Toccoa) are tributaries of the Tennessee River, and eventually the Mississippi River.

Table 3.4.1. Sixth-field Project Watersheds.

Watershed Number	Watershed Name	National Forest (acres)	Private Land (acres)	Total Acres	Percent National Forest
060200020505	Coosa Creek	6,386	7,978	1,4364	44
060200020506	Youngcane Creek	4,187	16,530	20,717	20
060200030102	Cooper Creek	23,445	1,845	25,290	93
	Total	**34,018**	**26,353**	**60,371**	**56**

Named streams in the Youngcane Creek watershed that are downstream of proposed treatment are Reynolds Branch and Payne Creek, tributary to Youngcane Creek, and Mason Branch, and Little Youngcane Creek. Mulky Gap Branch, Gillespie Branch, Miller Cove Branch, Jones Branch, West Fork Coosa Creek, and East Fork Coosa Creek in addition to multiple unnamed tributaries that flow into the Coosa Creek Watershed. The streams within Coosa Creek and Youngcane Creek watersheds generally flow north onto private lands. The proposed treatments in these watersheds lie mostly within the North Duncan Ridge and North Blood Mountain Landtypes.

Cooper Creek is the dominant hydrologic feature within the project area and Cooper Creek watershed. Sea Creek, Long Cove Creek, Clements Branch, Dixon Creek, Mulky Creek, Millshoal Creek, Long Branch, Soapstone Branch, Pretty Branch, Bryant Creek, Burnett Creek, Tigue Branch, Logan Creek, Board Camp Creek, and Jarrard Creek comprise the named tributaries that drain areas proposed for vegetation treatments within the Cooper Creek watershed. Additional streams that drain areas with proposed road management changes without vegetation treatment are Knight Creek, Helton Creek, Turkey Creek, and Flat Creek. Cooper Creek generally flows west reaching the confluence with the Toccoa River that flows north. A majority of the land area within Cooper Creek watershed extends from Cooper Creek north to Duncan Ridge. Proposed vegetation treatments within Cooper Creek watershed all lie to the north (right bank) of Cooper Creek.

Precipitation

The NRCS soil survey states the average annual precipitation for Union County is 62 inches, with 3 inches falling as snow. Average annual precipitation in the project area ranges from 55 inches to 73 inches. The annual precipitation is about 55 inches in the northern project area and gradually increases to the south and east in the Cooper Creek Watershed (NRCS, 2010). Winter months average the most precipitation, although every month averages substantial precipitation, usually as rain. October is typically the driest month. Higher elevations receive about 5 days of snow per year. Widespread drought occurs approximately once per decade.

Terrain predominantly influences precipitation patterns in the project area. Soils are predominantly hydro group A and B indicating a high to moderate infiltration rate (low to moderate runoff potential) when thoroughly wet. These soils have a high to moderate rate of water transmission. The ability to transmit water indicates that storm water is delayed rather than being transported immediately through the watershed stream network as runoff. The result is a hydrograph with a longer time to peak flow. That combined with the frequent rainfall and long growing season greatly influences the hydrologic function in the project area. A high percentage of streams in the Blue Ridge area are perennial in comparison to other locations in the U.S. Streams are fed consistently by baseflow. Perennial streams occur high on the slopes in the headwaters of the watershed. While the watershed is not flashy, the steep slopes and channel gradients have the ability to transport large amounts of water and sediment, especially once saturation is reached. The high permeability of the soils in riparian areas stream channels provides the ability to move water between surface and subsurface. The relatively high amounts of water through the soil as baseflow provides filtering of the water and allows fine soil to settle.

Water Quality

The objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands. There are no municipal watersheds or public owned treatment works (POTW) in the project area.

Water quality standards are made up of three components:

1. Designated uses: There are six designated uses in Georgia including (1) fishing, (2) drinking water supply, (3) recreation, (4) coastal fishing, (5) wild river and (6) scenic river

2. Numeric and Narrative water quality criteria: Criteria are put in place to protect the designated use. Numeric water quality criteria have been adopted for a number of parameters including dissolved oxygen, pH, temperature, bacteria, metals, pesticides and other organic chemicals. An example of a narrative criterion is the prohibition of discharging toxic materials in toxic amounts.

3. Antidegradation Policy: States must develop an antidegradation policy and an implementation method to protect and maintain water quality using a tiered approach. The purpose of the antidegradation policy is to develop a set of procedures to be followed when evaluating activities that may impact the quality of the waters of the State. Antidegradation implementation is an integral component of a comprehensive approach to protecting and enhancing water quality.

Designated uses of surface relevant to the project area are Recreation, and Drinking Water, and Fishing, Propagation of Fish, Shellfish, Game, and Other Aquatic Life.

A part of the CWA is Section 303(d) which requires a list to be developed and updated every two years on even numbered years of all impaired waters with each state. The Georgia State Environmental Protection Division (EPD) is responsible for compiling the 303(d) list, assessing data, and submitting the 303(d) list to the Environmental Protection Agency (EPA) for federal approval. The EPD and EPA frequently require a Total Maximum Daily Load (TMDL) for 303(d) listed streams.

The proposed treatments are located in headwaters to several stream reaches that are listed as 303(d) impaired. These streams are Youngcane Creek, Coosa Creek, East Fork Coosa Creek, Little Youngcane Creek, and Cooper Creek (Table 3.4.2, Figure 4.3.1). The current status for these listed streams notes that a TMDL is required. The 303d listed segments of Youngcane Creek and Little Youngcane Creek are on private land downstream of the project area. Only a small area in the upper reaches of Little Youngcane Creek is proposed for prescribed burn treatment. The listed segment of Coosa Creek is also on private land and downstream of an unimpaired reach of Coosa Creek. The listed segment of East Fork Coosa Creek begins on Chattahoochee National Forest, travels onto private land for about 1.25 miles, briefly back onto the Chattahoochee National Forest, and then downstream onto private land. The Cooper Creek segment is all Forest Service land.

Table 3.4.2. EPA 303d Impaired Streams

Watershed Number	Stream Name	Designated Use	Impairment	Reach Length (miles)
060200020505	Coosa Creek	Fishing	Biota Impaired (Cause Unknown)	1.0
060200020505	East Fork Coosa Creek	Fishing	Biota Impaired (Cause Unknown)	6.0
060200020506	Little Youngcane Creek	Fishing	Biota Impaired (Cause Unknown)	4.0
060200020506	Youngcane Creek	Fishing	Biota Impaired (Cause Unknown)	4.0
060200030102	Cooper Creek	Fishing	Biota Impaired (Cause Unknown)	10.0
	Total			**15.0**

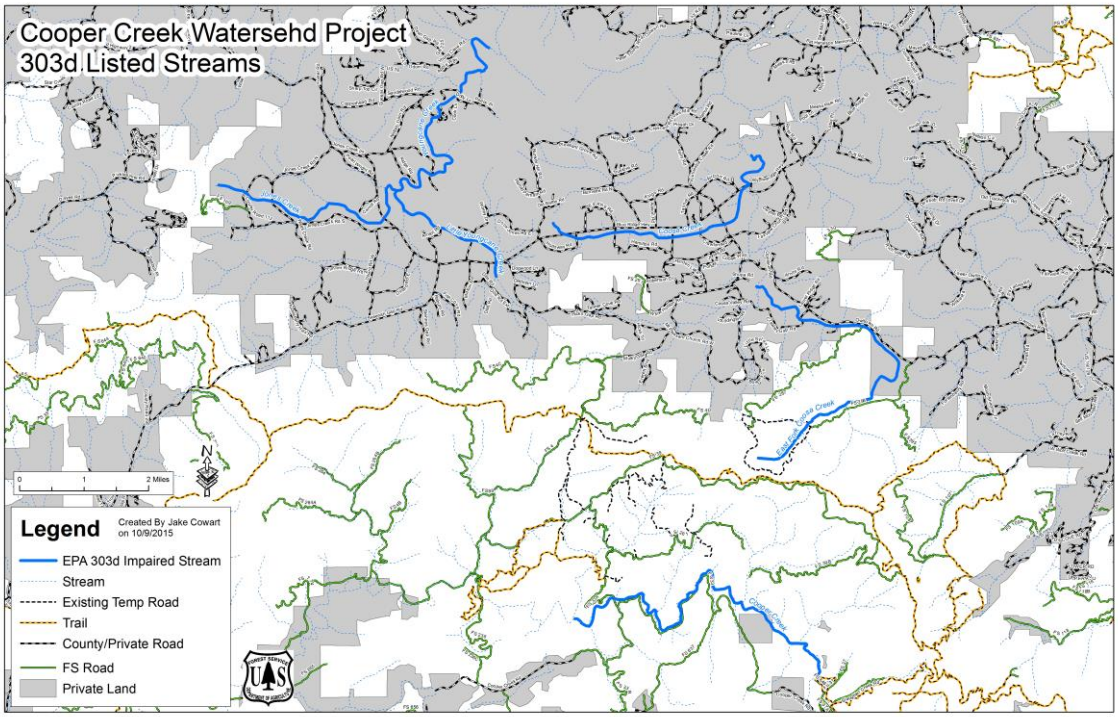

Figure 3.4.1. EPA 303d Impaired Streams

Little Youngcane Creek was listed as sediment impaired (biota impacted) stream and a TMDL evaluation was completed for Little Youngcane and seven other stream segments identified as sediment impaired in January 2004. The TMDL notes that in 1993, the Tennessee Valley Authority (TVA) conducted macro invertebrate population studies. The general cause of the low scores was determined to be lack of habitat due to stream sedimentation. The TMDL analysis found a positive correlation between the reduction in farmland and soil erosion. This suggests that the sedimentation observed in the impaired stream segments may be legacy sediment resulting from past land use practices. The subsequent recommendation of the TMDL was to maintain sediment loads at acceptable level so that streams could repair themselves over time (TMDL, 2004). The summary of conditions for the Tennessee River Basin determined that row crops contributed 68% of the sediment load, roads contributed 33%, and forested land contributed 5% of the sediment load. Forested land comprised 83% of the land base while row crops comprised only 2.3% of the land base. Management of Chattahoochee National Forest played a small role, if any, in the listing of Little Youngcane Creek in 2004 TMDL.

The methodology that produced current 303d list of streams is different from the protocol described in the 2004 TMDL. The cause of impairment Sediment (Biota Impacted) vs. Biota Impaired (cause unknown) is also different, but similar. A TMDL has not been completed for the currently listed streams. An inference that following the guidance for managing non-point source with Best Management Practices is adequate to address the current stream listings can be made.

The Blue Ridge province receives acidic deposition considered at some of the highest levels in the Eastern United States. Emissions have dropped as a result of required emission reductions by the Clean Air Act Amendments of 1990. Despite the drop in emissions, acidic deposition is still above natural background levels. Studies in the Appalachian Mountains, including the project area, indicate sulfate concentrations in streams have increased over the last decade while the acid neutralizing capacity

(ANC) has decreased (Elwood et al, 2012, Webb, 2004). Streams within the project area are considered vulnerable to acidification. Multiple water quality samples for acidity, anions, and major cations were collected in Cooper Creek in 2012. The results show a vulnerability to acidity. Sulfate is shown as the dominant anion, electrical conductivity is low (<40 uS/cm), and ANC indicates low buffering capacity. Values of ANC ranged from 70.5 – 247 uE/L. ANC is considered an indicator of acidity whereas pH is a measure of acidity. Brook trout are considered comparatively acid tolerant as a species and have a variable response to ANC below 50uE/L while many other fish and aquatic species are less tolerant. (Bulger et al., 2000). ANC values of <20uE/L are potentially lethal to Brook Trout and many other aquatics.

Eastern hemlocks in the project area are at risk from the Hemlock Woolly Adelgid (HWA), an invasive insect that targets hemlock. Hemlock are shallow rooted and prefer moist riparian sites and play an important role in regulating stream flow and moderating water temperature. Seasonal changes to local forest hydrology may occur depending on which species replaces the hemlock because of varied transpiration (Brantley 2013). Climate change models predict rising air temperatures in the project area although models vary by how much. Loss of Hemlock in the project area is occurring and likely to worsen despite efforts to control the HWA. Water temperature of streams in the project area are likely to rise as a result of both climate change and loss of the eastern hemlock.

Riparian Corridors and Ephemeral Streamside Protection Zones

Chapter 1, section 1.5 of this document describes the Chattahoochee Forest Plan management area and management prescriptions. Design criteria and best management practices applied to protect water resources will not vary between management prescription areas except within riparian corridors. This prescription area encompasses riparian areas, as well as adjacent associated upland components (LRMP).

Riparian corridor widths are designed to encompass the riparian area defined on the basis of soils, vegetation, and hydrology as described in detail in Appendix C of the Chattahoochee-Oconee Forest Plan. Table 4.3.3 describes riparian corridor widths unless site-specific delineation is determined necessary by soil scientist or hydrologist. For perennial and intermittent linear water features the riparian corridor widths are measured in on-the-ground surface feet perpendicular from the edge of the channel or bank. For lentic features including ponds, seeps, wetlands, the measurement is made from the ordinary high water mark (LRMP). Approximately 8% of the Blue Ridge ecological section supports riparian systems on perennial streams (FEIS).

Ephemeral channels do not have riparian vegetation, flow only in response to overland flow from precipitation events and snowmelt, and are above the water table all year, or in rare cases, most of the year. Ephemeral channels contain both alluvial and colluvial material that is captured from gravity and surface flow. The soils typically have a somewhat finer substrate than surrounding uplands, but not to the extent found in riparian areas. The ephemeral stream zone is identified as 25 feet on each side of an ephemeral channel with evidence of scouring. Scouring is described as movement of the duff or litter material on the surface due to water movement, exposing the soil or parent material below. The width of ephemeral stream protection zones are not slope dependent.

Riparian corridors do not apply to constructed ponds developed for recreation uses, human made ditches, dry gullies, or other features that are maintained or in the process of restoration (LRMP). The instruction sheet for complying with Georgia's pesticide general permit (GAG820000) BMP 1b) states

that intact streamside management zones (SMZ) along a watercourse where no pesticides are applied, are adequate buffers to prevent direct discharge to waters of the state. Waters of the state include all surface and subsurface water bodies, natural or artificial which are not entirely confined and retained completely on the property of a single individual, partnership, or corporation. BMP 5) states that in the case of roadside spraying: Pesticides applied to roadside ditches, where water is not "connected" to waters of the state do not count toward the calculation of the Notice of Intent Threshold. Consequently a design feature for this project limits roadside spraying in proximity to surface water features and ditches that have hydrologic connectivity and water is present or there is a high probability of precipitation. A no-herbicide zone of 25 feet for artificial channels such as roadside ditches that have hydrologic connectivity to waters of the state.

Field observations have noted that perennial streams are understated on the National Hydrography Data (NHD) stream layer. Only a few intermittent streams are identified on the NHD layer.

Table 3.4.3. Minimum Riparian/Water Protection Zones.

Protection Measure	Water Feature	Slope Class	Width (feet)
Riparian Corridor	Perennial and Intermittent Surface Waters and Groundwater dependent ecosystems	0-30%	100
Riparian Corridor	Perennial and Intermittent Surface Waters and Groundwater dependent ecosystems	31-45%	125
Riparian Corridor	Perennial and Intermittent Surface Waters and Groundwater dependent ecosystems	46%	150
Ephemeral Protection	Ephemeral Channels	N/A	25
Roadside SMZ for herbicides (Project-level design feature)	Roadside ditch or other artificial channel not included in other protection zone.	N/A	25

Human Use

Historic and current use has affected the current hydrology of the watersheds within the project area. Native Americans most dramatically influenced the landscape by frequent burning. Early settlers made more rapid and dramatic changes to the landscape through establishing settlements, agriculture, logging, road building, etc. Accelerated erosion from these activities increased sediment loading in stream channels for transport through the stream channel network. Changes to stream channel morphology took place at unknown intervals in history and some remnants of these changes as well as sediment load exist today. Recovery of these changes has occurred in some instances and the current conditions reflect a mix of a tumultuous natural geologic history and more recent human intervention.

Response reaches (low gradient valley bottoms) show abundant sediment deposition. Current management within the project area as well as lands outside the project area have seen a decrease in sediment as land management practices have been moderated and BMP implemented.

Current sources of sediment above natural background levels come primarily from roads. Many roads meander into riparian corridors and increase hydrologic connectivity. Roads simultaneously forcing water to concentrate, provide an impermeable surface, reduce surface roughness that increase the velocity of the surface runoff thereby increasing the ability to both erode and transport sediment. Roads, especially on steep hillslopes denude a greater area because of more cut and fill slopes that are exposed and over steepened per lineal distance than roads on more gentle slopes. The roads cut banks also result in more erosion by releasing baseflow traveling in the soil. Road in proximity to streams greatly increase the sediment to transport of sediment to streams.

Most dispersed recreation in the project area is water centric and results in frequently denuded and trampled stream banks that increase erosion and sediment to channels.

3.4.2 Effects on Water Resources

Measure: The hydrologic factors considered in this analysis pertain to water quality, quantity, and the timing of flow. Water quality parameters considered are sediment and turbidity, water temperature, nutrients, and herbicide (Triclopyr).

Sediment and Turbidity

Loosely defined sediment is generally referred to as eroded soil that has entered the stream channel. Sediment may be in the form of bedload which bounces and moves along the stream bottom, or be suspended. Suspended sediment may settle in time to the stream bottom. It may adversely affect fish and other aquatic fauna by filling in pools, reducing bottom fauna, and silting in spawning gravels. Sediment delivery is dependent on the erosivity of upland soil, slope, and distance to a stream, effective ground cover, rainfall intensity, and continuity of disturbance. Suspended sediment can increase turbidity which is the ability of light to pass through water. Excessive turbidity reduce light penetrated therefore, reduces photosynthesis by phytoplankton, algae, and submerged vegetation. Turbidity is often used as a surrogate to indicate changes in suspended sediment.

Water temperature

Streams within the project area designated as cold water trout stream. Streams maintain cool temperatures to sustain cold water fisheries through adequate shade along stream channels, adequate stream volume, and subsurface flow.

Nutrients

The U.S. Environmental Protection Agency (EPA) has published a National Strategy for the Development of Regional Nutrient Criteria. The strategy describes the approach the EPA will follow in developing information concerning the role of nutrients in waters, and how it will work with States to develop numeric nutrient criteria. The EPA's primary goal is to work with States to establish the necessary criteria to reduce nutrient over-enrichment of all of the nation's waters. Nutrient over-enrichment is defined as the accumulation of nutrients from human activities and natural sources that impairs the beneficial uses of a waterbody. In response GA EPD has developed and submitted to the EPA a conceptual approach to nutrient criteria development. Currently there are no numerical standards

for nutrients in streams and rivers. GA EPD has mapped surface waters in the project area as high attainment areas.

Triclopyr (Amine)

There is no numeric State water quality standards for the herbicides or adjuvants that may be used in either of the action alternatives.

***Bounds of Analysis*:**

The spatial analysis considers the three HUCs, Coosa Creek (060200020505), Cooper Creek (060200030102), and Youngcane Creek (060200020506). The temporal scale is for approximately ten years.

Alternative 1: No Action

Direct and Indirect Effects

Under the no action alternative, none of the proposed silvicultural treatments including thinning, harvest, site prep, and release) and proposed transportation management treatments (closure, road maintenance and reconstruction, temporary road construction, parking area improvements) would occur in the project area. However, the previously approved dormant season prescribed burns would occur under the no action alternative. The effects describing these the prescribed burns are discussed in detail under Alternative 2. Consequently, no direct affects would result from implementation of this alternative to water resources. Fewer objectives identified in the need for action would not be met. Short term indirect effects to water resources would be minimal. Localized benefits from road closures would not be realized. Maintenance of non-point sources of sediment on roads would be delayed. Temporary increases in sediment from ground disturbing activities would not occur. Long term indirect effects to water resources are unknown. Current trends of forest vegetation transition and climate change predictions indicate reduced ecological resilience and increased risk to wildfire. Hydrologic function including maintenance of water yield, water quality, and resistance to flood damage are correlated with forest health.

Cumulative Effects

Because there would be no action with which to combine the effects of past, current and foreseeable actions, there would be no cumulative effects according to definition provided in 40 CFR 1508.7.

Alternative 2: Proposed Action

Direct and Indirect Effects

Alternative 2 proposes multiple vegetation treatments (silvicultural, site prep, release, herbicide, prescribed burns) and several transportation management activities are described in Chapter 2. The proposed transportation management activities for temporary road construction, and road reconstruction are to support the proposed vegetation management treatments. Multiple road closures and changes in maintenance level designed to meet different objectives.

The proposed vegetation treatments sans prescribed burn vary geographically and in volume, but are otherwise similar. The potential effects to water resources are the same qualitatively in both action Alternatives.

Roads

Approximately five miles of temporary road construction would occur in Alternative 2. Temporary road construction, would utilize previous road templates where they exist unless segments of the road template would not meet design criteria requirements. Utilizing existing road templates would cause less displacement of soil. Three and one half miles of existing temporary roads would be opened and reconstructed and 1.5 miles of new temporary roads would be constructed. Approximately 1.5 miles of these temporary roads are located in Coosa Creek Watershed, and the remaining 3.5 miles are located in Cooper Creek Watershed. These roads would be closed, stabilized for storm proofing, and re-vegetated after use.

Road reconstruction would occur on 2.8 miles of roads located in Coosa and Cooper Creek watersheds (Table 3.4.4). Road construction would be needed for curve widening/realignment, to accommodate timber hauling. The proposed reconstruction also includes reshaping segments of the road way to improve drainage, install water controls, and replace existing culverts and other drainage structures to meet current standards and Best Management Practices (BMP).

Table 3.4.4. Proposed Road Reconstruction.

Road Name	Road Number	Watershed	Estimated Mileage
Mulky Gap	4	Coosa Creek	**0.2**
Spencer Mountain	4D	Coosa Creek	**0.6**
Cooper Creek	33	Cooper Creek	**0.2**
Bryant Creek	33A	Cooper Creek	**0.6**
Duncan Ridge	39	Cooper Creek	**0.7**
Burnett Creek	261	Cooper Creek	**0.3**
Gillespie Branch	287	Coosa Creek	**0.2**
Total			**2.8**

Sediment and turbidity and changes in hydrologic connectivity are the primary concerns to water resources with respect to roads. Road reconstruction and temporary road construction would result in a short term increase of sediment reaching stream channels. Stream capacity to move the sediment downstream would dictate how long the sediment would remain in the project watersheds. Design criteria can reduce the amount of sediment delivery from road construction, but does not eliminate it. The greatest risk of increased sediment volume is during and immediately after construction before stabilization and re-vegetation occurs. This period combined with substantial precipitation of long duration and/or high intensity would greatly increase the amount of sediment to channel. Design features that include temporary measures to slow water movement and capture sediment during and immediately following construction would reduce the volume of sediment to channel.

Long term benefits from replacement of culvert/drainage structures and water controls would be a reduction in sediment to channel. Improving the stream crossings reduces risk of road/stream crossing failure that would result in a surge of sediment to channel.

Road density would not increase to an extent that it would change the hydrologic connectivity, and therefore the timing or quantity of runoff.

Several roads or road segments are proposed for year-round (Table 3.4.5) or seasonal closure (Table 3.4.6) in Alternative 2. These roads have maintenance concerns that result in sediment delivery to channels. Many of these roads have long segments within the stream buffer or run parallel to streams.

Reduction of road traffic, particularly during winter months when roads have less opportunity to dry between precipitation events would result in less sediment delivery to channel.

Table 3.4.5. Proposed Year-Round Road Closures and Distance of Roads Near Streams.

Road Name	Road Number	Watershed Name	Estimated Mileage	Miles in 200 Foot Buffer	Miles in 100 Foot Buffer	Stream Name
Mark Helton Branch	33B	Cooper	4.5	0.21	0.05	Helton
Duncan Ridge Branch	39B	Cooper	2.2	0.45	0.01	Board Camp
Total			**6.7**	**0.66**	**0.06**	

Table 3.4.6. Proposed Seasonal Road Closures and Distance of Roads Near Streams.

Road Name	Road Number	Watershed Name	Estimated Mileage	Miles in 200 Foot Buffer	Miles in 100 Foot Buffer	Stream Name
Flatlands	637	Cooper	1.5	0.24	0.05	Turkey, Flat
Knight Creek	264A	Cooper	2.9	1.08	0.56	Knight
Longcove Creek	264B	Cooper	1.2	0.92	0.26	Longcove
Gillespie Branch	287	Coosa	2.0	0	0	Gillespie
Dixon Branch	88	NA	3.7	NA	NA	
Duncan Ridge (portion)	39	Cooper	3.0	1.71	0.78	Cooper, Millshoal
Bryant Creek	33A	Cooper	3.3	1.03	0.61	Cooper, Bryant
Sea Creek	264	Cooper	4.0	2.51	1.24	Sea
Total			**21.6**			

Two roads, Lake Winfield Scott Branch C and Lake Winfield Scott Branch D would be reclassified to maintenance levels 4 & 3, respectively. These roads are currently maintained at these higher maintenance levels. This change would be primarily administrative and would not affect water resources.

Prescribed Burning

Prescribed burning is conducted in the Southeast by the Forest Service over a greater area of land with more frequency than in other Forest Service Regions. Despite this, more studies have been conducted in the western U.S regarding the effects of prescribed fire and wildfire. Factors most likely to affect water resource include physical, biological, and chemical impacts to soil. The potential affects to soil are addressed in the Soils section of this environmental assessment. The most common effects to water resources from wildfire and prescribed fire are increased sediment and turbidity, increased storm runoff and altered baseflow, changes to water chemistry (e.g. pH, nitrogen, phosphorus, and cations), and water temperature.

Fire severity describes the magnitude of ecological changes that occur both above and below the soil surface that in turn determines to a great extent the impacts to water resources. Fire lines to control the extent of either a prescribed burn or wildfire can also impact water resources. Typically wildfires burn with greater severity, that result in greater impact to water resources than prescribed burns.

Table 3.4.6 describes the proposed burn units for the Cooper Creek Watershed Project action alternatives (2 & 3). The proposed burns would occur over a period of years, distributing effects temporally. The total acreage of proposed burns in Youngcane Creek Watershed comprise 9.5% of the Forest Service lands within the watershed and 2% of the total watershed. The total acreage of proposed burns in Coosa Creek Watershed comprise 14.5% of the Forest Service lands within the watershed and

6.5% of the total watershed. The two larger burns in Coosa Creek watershed, Fish Knob and Spencer Mountain, would likely not occur at the same time, thus distributing the effects temporally. Cooper Creek Watershed is 93% Forest Service and the total proposed acreage for prescribed burn is 42% of the watershed. No more than 6000 acres of prescribed burning would be implemented in one year. The annual goal for prescribed burning within the project would be 2000 to 4000 acres per year.

Burn unit prescriptions vary based on aspect, slope location, and ecological objective. High to moderate intensities are desired for the south and west facing xeric ridges. Moderate intensity is desired for midslope and low intensity for riparian and trail corridors, and mesic hardwood stands. Units would burn in a mosaic pattern. Depending on site conditions the correlation between fire intensity and fire severity and impact to soil varies.

Except for localized pockets where high accumulations of large woody fuels may exist, minimal soil disturbance would be expected. Local monitoring from previous prescribed burns shows little effect to the organic soil layer. Literature review of prescribed burns in the Southern Appalachians report findings consistent with these results. No more than minimal sediment above background levels for a short duration would be expected on these burn units. With the organic layer intact, available seed source, abundance of plants to re-sprout coupled with high soil moisture and warm temperatures ground vegetation would rapidly reestablish. Because riparian corridors would burn at low intensity, stream shade would not be reduced below required standards and hillslopes would still remain forested. Water temperature would not be impacted from prescribed burning.

The more common water chemistry parameters associated with wildfire and prescribed fire are nitrogen (N), phosphorus (P), calcium, (CA), magnesium (Mg), and potassium (K). Different compositions of these elements in addition to other minerals including sulfur, metals, pH, and dissolved oxygen can be affected. Nitrate and sulfate are among the most mobile forms of nitrogen and sulfur. These anions are of concern because of stream vulnerability low acidification. A literature review of surface water monitoring of eastern wildfire and prescribed fire for N, P, S, and cations indicate little if any fluctuation of these compounds would occur. Wildfire was more likely to show small increases than prescribed fire. If increases were to occur in surface waters as a result of the prescribed burns, they would not be expected to occur in elevated concentrations to cause impairment of surface waters or designated uses (Kolka, 2012).

Increased water yield would be possible in drainages for a short duration (1 – 2 years) until reestablished vegetation increased transpiration. The amount of increased water yield from a limited number of drainages dispersed through Cooper Creek Watershed would not produce flows at a high enough level to increase flooding downstream. In all likelihood the increases from prescribed burning alone would not result in measurable increases. The greatest risk to flooding events post-fire comes from hydrophobic soils and stand replacing fires. Occurrence of hydrophobic soils in the east rarely occurs following prescribed fire and burns conducted in prescription would not remove extensive basal area.

The use of roads, streams, and construction hand line will be maximized in order to minimize disturbance from dozer fire line. The dozer and hand lines would have water controls in place to minimize water concentrating on the lines. Most dozer lines are old road beds that contour. Generally minimal ground disturbance is needed to reutilize these lines. If a dozer line needs re-blading due to high deadfall or rapid brush regrowth, sections with high erosion potential would be seeded to hasten

re-vegetation. Historically litter from leaf fall and rapid re-growth of vegetation in dozer lines occurs rapidly because of available moisture and warm temperatures. All of these factors would minimize erosion on the constructed lines and prevent measurable sediment from reaching stream channels.

Table 3.4.6. Proposed Prescribed Burn Units (all Alternatives).

Burn Name	Acres	Cooper Creek	Coosa Creek	Youngcane Creek
Addie Gap	551	551		
Bryant Creek	1,375	1,372	3	
Cliff Ridge	1,543	1,543		
Coosa Bald	2,143	2,141	2	
Coosa Bald Addition 1	383	360	25	
Coosa Bald Addition 2	200	190	10	
Coosa Bald Addition 3	62	62		
Dunsmore Mountain	1,155	1,118		37
Fish Knob	1,764	1,080	324	360
Rich Ridge	1,161	1,161		
Spencer Mountain	1,502	937	565	
Total	**11,842**	**10,515**	**930**	**397**

Comparison of Alternative 2 to Alternative 1 (no action)

Historically the main fire season in the project area occurred during the growing season. Alternative 2 would implement prescribed burns in both the dormant and growing season. Currently prescribed burns in the project area are conducted in the dormant season, primarily in February and March. The dormant season is generally from November through mid-April. The growing season is described as mid-April through October. The primary timeframe for prescribed burning during the growing season under Alternative 2 would be from mid-April through May. The objectives for implementing prescribed burns in both the dormant and growing seasons are described in the objectives of chapters 1 and 2 of this environmental assessment. Based on existing literature reviews (Knapp et al, 2009) and the primary implementation periods for prescribed burning, effects to water resources would not be notable between the no action Alternative (dormant season only) and Alternative 2 (dormant and growing season).

Timber Harvest/Silviculture Treatments

A summary of the proposed Alternative 2 treatments area by treatment type and 6th-field watershed is displayed in Table 3.4.7. A description of the treatments and objectives is described in Chapter 2 and an index of all units in Appendix E.

The proposed vegetation treatments in Alternative 2 have potential to effect water resources. The removal of vegetation and ground disturbance, particularly from skid trails and landings has potential to increase sediment and turbidity, increase water yield, change water chemistry (e.g. nitrogen, phosphorus, and cations), and increase water temperature. In this section, all proposed vegetation treatments except for herbicide and prescribed burning are referred to as silvicultural treatments.

The maximum total acres prescribed for treatment is 3,754 acres. Although treatments are permitted within riparian corridors, not all the area within the corridors would be treated because of mechanical equipment exclusion. Within the 100 foot streamside management zone (SMZ) there would not be any harvest within 25 feet of any stream and within the next 75 feet the minimal basal area (BA) remaining after harvest would be 50. Limiting the amount of ground disturbance within the SMZ would greatly reduce the potential for sediment to be directly introduced into aquatic habitats. The 25 foot buffer next

to the streams would allow streams to remain shaded and maintain help maintain cold water temperatures in the streams. Other areas within stands may also not be feasible to treat because of terrain, or other resource objectives. No silvicultural treatments are proposed in Youngcane Creek.

Coosa Creek watershed is 44% National Forest lands. Proposed treatment stands encompass 28% of Forest Service lands and 13% of the watershed. Of the stands proposed for treated, approximately 85-90% of the area within the stands would be treated. The level effects from treatment in these drainages would be mitigated through the timing of timber sales and sequencing of entry into units. Treatments are proposed in southern half of the watershed which drains mostly north. Proposed treatment stands are located in the East Fork Coosa Creek and West Fork Coosa Creek drainages. When these two tributaries converge, the stream becomes Coosa Creek.

Commercial treatments which require skid trails and landings and generally involve more ground disturbance per area are proposed for 25% of the stand acres. The majority of treatment proposed in the West Fork Coosa drainage span from the watershed boundary south to three perennial streams, Mulky Gap, Miller Cove Branch, and West Fork Coosa Creek, and an unnamed tributary of West Fork Coosa Creek. Streams in the headwaters have the greatest potential to transport sediment while at the same time provide delay in sediment transport to downstream reaches. The East Fork of Coosa Creek is horseshoe shape that meanders around Bowers Mountain. Proposed treatments are generally on either side of Bowers Mountain ridgeline. Some of the stands drain south into the extreme headwaters of East Fork Coosa Creek while the majority of proposed treatments are in drainages that flow north into Gillespie Branch, and unnamed tributaries to the East Fork Coosa Creek further downstream. The spatially dispersed stream network also provides delay in transport of potential sediment resulting from the proposed action.

Table 3.4.8. Proposed Alternative 2 Silvicultural Treatments.

Vegetation Treatment	Total Acres	Cooper Creek	Coosa Creek	Youngcane Creek
Canopy Gap - Commercial	466	1	465	
ESFH	253	151	102	
Midstory	1056	198	858	
Oak/Oak-Pine Thinning	112	29	83	
Pine/Pine-Oak Thinning	843	644	199	
Release	260	176	84	
Woodland - Commercial	641	619	22	
Woodland - Noncommercial	123	117	6	
Total	**3,754**	**1,935**	**1,819**	**0**

Cooper Creek watershed is 93% National Forest lands. Alternative 2 proposed treatments comprise 8% of the Cooper Creek Watershed. Approximately one-third of the treatment proposed in Alternative 2 is commercial. If these treatment were to occur in a shorter timeframe, effects to streams immediately downstream would be increased in magnitude. Conversely, if the treatments were staggered with greater time intervals, the effects would lessen in magnitude and become more localized. The level effects from treatment in these drainages would be mitigated through the timing of timber sales and sequencing of entry into units. Cooper Creek watershed is elongated with Cooper Creek as the dominant hydrologic feature running from east to west. More land area lies to the north of Cooper Creek. All of the proposed silviculture treatments are also north of Cooper Creek in the mid-watershed. Approximately 85% of the proposed treatments drain into Bryant Creek, a tributary to Cooper Creek. The approximate drainage area of the Bryant Creek sub-watershed is 3,170 acres. Silviculture treatments are proposed for approximately 1,620 acres or 51% of Bryant Creek sub-watershed. Of these

proposed treatments approximately 75% of these involve commercial harvest. The palmate shape of the stream network within the Bryant Creek sub-watershed indicates a rapid time to peak flow on the hydrograph at the confluence with Cooper Creek.

State water quality requirements consider proper design, installation, and maintenance of Georgia Forestry Commission Best Management Practices and compliance with issued permits shall constitute compliance with Paragraph 391-3-6-.03(5)(d). Repeated studies of best management practices to be effective in reducing sediment delivery to streams. Streamside protection zones have shown to be a critical management practice in reducing sediment transport to streams.

Potential exists for increased water yield as a result of silvicultural treatments in Alternative 2. Numerous studies have documented changes in water yield based on silvicultural treatments in the eastern U.S. since at least the 1960s. The amount of change to volume is dependent on several factors. Clear cutting or clear cutting with herbicides seemed to have the highest increase, but size of the area treated is also relevant. The percent of basal area reduction is reported to be in important factor. Overstory removal seems to increase yield more than understory removal; however, treatment of mountain laurel and rhododendron can have substantially increase water yield. The water yield increases because of the change in vegetation transpiration and in some cases interception. Overstory removal and vegetation type (e.g. pine vs. hardwood) will have greater influence on interception. Many studies show a correlation with aspect influencing water yield as well. Northern aspects may have changes to water yield twice that of southern aspects. Aspect may also influence when seasonal increases are most pronounced. If soil moisture levels are high during growing season as is common in the project area, water yield may occur later in the growing season. Recovery to pretreatment levels in the project area would likely be rapid, 5 – 10 years (most recovery in one to two years) because of productive soils, available vegetation to re-sprout, and the long growing season. What was found consistent among literature is that while the volume of water yield may be substantial, it rarely affects peak flows especially for extreme events because of varied response time in treatment units. The increase in yield is seen throughout the year and is part of the baseflow. In smaller watersheds with palmate patterns, such as Bryant Creek, peak flows may be affected somewhat more.

Reduction of the percent basal area would vary based on existing conditions, the treatment prescription, and the percent of area treated in each stand. The maximum percent of area that would be treated for each stand is estimated to be 85- 90%. Canopy Gap treatments proposed in Alternative 2would reduce basal area by about 25%, Midstory treatments would range from 25 – 40% reduction, and thinning treatments about 60%. ESFH would be reduced by 80 – 90%. Woodland treatments would reduce basal area by 60 – 80%. Initially, an increase in water yield would be expected for each of these treatments. Early seral forest habitat treatments would recover more rapidly after replanting occurred. The recovery of current water yield levels of Woodland treatments would occur as grasses become established. The level of transpiration would be dependent on the productivity of the grasslands.

Treatment of riparian corridors would occur; however, stream shade would not be reduced below required standards. Other than canopy gap treatments on upper slopes, the majority of the landscape would still maintain similar canopy cover. Thus, water temperature would likely not be impacted from the proposed harvest treatment.

Vegetation removal has the potential to release nutrients including nitrogen (N), phosphorus (P), calcium, (CA), magnesium (Mg), sulfur, (S) and potassium (K). Different compositions of these elements The Forest Service Southern Research Station has conducted a long term study on water

quality responses to clear cutting. In-stream changes in solute concentrations were detected. Small initial nutrient losses occurred following treatment, but rapidly recovered and were followed by increased concentration of nitrate (Swank et al, 2001). Though changes were detected, they considered minor and short-term. Other studies conducted in the eastern US also report similar results. Most studies involve more intensive management than that proposed in Alternative 2 per unit area (Clinton et al, 2012)

Herbicide

Herbicide use is proposed for Midstory, Oak/Oak-Pine Thinning, Pine/Pine-Oak Thinning, Release, and Woodland – Commercial and Non-commercial treatments Alternative 2. Objectives for each of these treatments are described in Chapter 2. Table 3.4.8 shows estimated acres of herbicide treatment per watershed.

Herbicide treatments include selective and targeted cut-surface (cut-stump and injection), directed foliar spray applications of Triclopyr (amine). There would be no aerial broadcast applications under this proposal. Results of the risk assessment for these pesticides on humans, aquatic and terrestrial animals, and terrestrial plants are given in Appendix F. Contamination of surface waters by herbicide treatments through drift, subsurface and surface movement would be mitigated by buffers (minimum 100 foot no-application zones),restrictive weather parameters, the use of selective application methods(backpack sprayers for streamline and foliar methods and low-volume spray-bottles for cut-surface treatments), and other design features and mitigations listed in Chapter 2. Contamination of surface waters by Triclopyr is considered unlikely because of design features and the imposed application buffer from any surface waters or stream channels.

The limited mobility of Triclopyr in soil, low absorption constant, and high rate of microbial and photolytic degradation in water and sediment would indicate that this compound would have little potential for the extensive mobility required to contaminate groundwater supplies.

Short term increases in water yield may occur from the use of herbicides where herbicides are used for release rather than to prevent vegetation from re-sprouting. The increase in water yield would not likely increase peak flow, but would likely increase baseflow during the growing season.

Accidental spills are not considered a direct or indirect effect of treatments in any of the alternatives. Project design features would reduce the potential for spills to occur. The concentration of herbicide in the water as a result of an accidental spill depends on the rate of application and the streams' ratio of surface area to volume. The persistence of the herbicide in water depends on the length of stream where the accidental spill too place, velocity of stream flow, and hydrologic characteristics of the stream channel. The concentration of herbicides would decrease rapidly downstream because of dilution and interactions with physical and biological properties of the stream system (Norris et al., 1991).

Table 3.4.9 Proposed Alternative 2 Herbicide Treatments.

Herbicide Treatment	Total Acres	Cooper Creek	Coosa Creek	Youngcane Creek
Triclopyr	3,251	1,934	1,327	0

The proposed herbicide use in Alternative 2 incorporate multiple layers of caution into the planning and implementation process of this environmental assessment, and is used in the analysis of water resources. These layers of caution reduce the risk of effects, including federal and Georgia State laws,

EPA label requirements, and SERA risk assessments. The incorporation of all of these precautions, in addition to site-specific design features, minimizes or eliminates the risks and effects of herbicide applications to surface waters.

Alternative 3

Direct and Indirect Effects

The effects for Alternative 3 are the same or similar to those described in Alternative 2. The discussion is limited to a comparison to the effects described under Alternative 2.

Roads

The effects to water resources from roads would be the similar in Alternative 2 and Alternative 3. The only differences are the year-round closure of an additional 2.4 miles and the decommissioning of 2.7 miles of system roads in Alternative 3. As a result, there would be a potential for further reduction in sediment delivery to streams in Alternative 3 as these road bed are stabilized.

Prescribed Burning

The effects to water resources from prescribed burning would be the same in Alternative 2 and Alternative 3. The proposed treatments are the same.

Timber Harvest/Silviculture Treatments

A summary of the proposed Alternative 3 treatments area by treatment type and 6th-field watershed is displayed in Table 3.4.9. A description of the treatments and objectives is described in Chapter 2 and an index of all units in Appendix E.

The proposed vegetation treatments in Alternative 3 have potential to effect water resources. The potential effects to water resources from silvicultural treatments is higher in Alternative 2 than Alternative 3 because more vegetation removal and ground disturbing activity is proposed in Alternative 2.

The maximum total acres prescribed for treatment is 2,571 acres. Although treatments are permitted within riparian corridors, not all the area within the corridors would be treated because of mechanical equipment exclusion. Although treatments are permitted within riparian corridors, not all the area within the corridors would be treated because of mechanical equipment exclusion. Within the 100 foot streamside management zone (SMZ) there would not be any harvest within 25 feet of any stream and within the next 75 feet the minimal basal area (BA) remaining after harvest would be 50. Limiting the amount of ground disturbance within the SMZ would greatly reduce the potential for sediment to be directly introduced into aquatic habitats. The 25 foot buffer next to the streams would allow streams to remain shaded and maintain help maintain cold water temperatures in the streams. Other areas within stands may also not be feasible to treat because of terrain, or other resource objectives. No silvicultural treatments are proposed in Youngcane Creek.

Coosa Creek watershed is 44% Forest Service. Proposed treatment stands encompass 12% of Forest Service lands and 7% of the watershed. Of the stands proposed for treated, approximately 85-90% of the area within the stands would be treated. The level effects from treatment in these drainages would be mitigated through the timing of timber sales and sequencing of entry into units. The effects would be of lesser magnitude and possibly of shorter duration in Coosa Creek.

Table 3.4.10. Proposed Alternative 3 Silvicultural Treatments.

Vegetation Treatment	Acres	Cooper Creek	Coosa Creek	Youngcane Creek
Canopy Gap - Commercial	100		100	
Canopy Gap – Noncommercial	104		104	
ESFH	229	128	101	
Midstory	358	125	233	
Oak/Oak-Pine Thinning	101	88	13	
Pine/Pine-Oak Thinning	740	627	1113	
Release	219	142	77	
Woodland - Commercial	489	482	7	
Woodland - Noncommercial	231	211	20	
Total	**2,571**	**1,803**	**768**	**0**

Cooper Creek watershed is 93% Forest Service and 7% of stand acreage has proposed treatment in Alternative 3. Proposed treatment would occur in 2017, 2018, 2019, and 2020. Approximately one-quarter of the treatment proposed in Alternative 3 is commercial. Alternative 3 has 132 fewer acres of proposed treatment and 138 less acres of proposed commercial treatment than Alternative 2. The effects to water resources in Cooper Creek watershed for Alternative 3 compared to Alternative 2 would be somewhat less in magnitude, but the duration and extent would likely be the same. The magnitude would be expected to be slightly less because of a reduction in treatment acres of 7%. Furthermore, less intensive ground disturbance would occur on 7% of the acres.

Herbicide

Alternative 3 proposes 1,925 fewer acres be treated with herbicide than in Alternative 2, a reduction of 60%. Alternative 3 is not expected to impair water quality.

Short term increases in water yield may occur from the use of herbicides where herbicides are used for release rather than to prevent vegetation from re-sprouting. The increase in water yield would not likely increase peak flow, but would affect baseflow during the growing season but would be less than Alternative 2.

Table 3.4.11. Proposed Alternative 3 Herbicide Treatments

Herbicide Treatment	Acres	Cooper Creek	Coosa Creek	Youngcane Creek
Triclopyr	1,327	1,019	438	0

Cumulative Effects Alternatives 2 & 3

The cumulative effects analysis must consider the effects caused by the aggregate of past, present, and reasonably foreseeable actions. Section 3.2 lists past, present, and reasonably actions in the project area. Effects can result from individually minor but collectively significant actions taking place over a period of time (40CFR 1508.7).

The effects may occur on-site or off-site through the transport of water. Off-site or downstream effects may be downstream of the activity or downstream of the project area. For this reason, activities were considered in context of watershed at the HUC 6 level. An effect does not indicate an impairment to water resource values.

Cumulative effects to water resources include direct and indirect effects as described above in Section 3.4. All of the components or activities of Alternatives 2 and 3 have common effects to water resources that are additive in terms of the spatial extent, duration and/or magnitude. Other activities described in Section 3.2 as well as dispersed recreation, climate change, the HWA, and acidic deposition described in the affected environment also contribute to potential cumulative effects.

Roads are recognized as the largest non-point source of sediment in southeastern forest landscapes. The existing road network is contributing sediment to streams in the streams in the project area. Maintenance (beyond annual maintenance planned) and reconstruction would also create a short term increase in sediment although likely result in a net decrease in sediment over time than would occur with no action. Construction and re-opening of existing temporary road templates would also result in short-term sediment delivery. Best management practices would be implemented on all road work, and none of the proposed road actions would be expected to deliver sediment of a magnitude or duration that would result in degradation to beneficial uses. Other foreseeable actions directly related to roads are crossing improvements with arch culvert installation. These improvements will reduce risk of road failure and improve aquatic passage.

The prescribed burns identified as reasonably foreseeable activities are the same burns proposed in Alternatives 2 and 3 except that burns would also be permitted during the growing season. These effects are described under direct and indirect effects.

Water quality from forested watersheds rates the highest when compared other land uses. Implementation of best management practices and adequate SMZ are accepted as reasonable protection of water quality. However, these practices do not eliminate risk from cumulative effects to water quality from the treatments proposed in Alternatives 2 and 3.

Increase to water yield in the short term is likely in Bryant and Gillespie Creek sub-watersheds. A large percentage of the land base with Bryant Creek, and Pretty Branch (a sub-drainage of Bryant Creek) is proposed for vegetation management. The increase would be greatest in magnitude and of shortest duration if all vegetation treatments occur within a short timeframe (e.g. 1-2 years). The increase in magnitude of water yield would be greatest immediately below the intensively treated areas. Because the increase in water yield is largely from reduced transpiration and interception from vegetation, the change in water yield is spread out throughout the year and does not proportionally increase peak flows. An estimate of local peak flow increase depending on treatment is 10-35%, but could be higher. Effects of increased water yield would be diluted quickly downstream extend beyond Coosa Creek and Cooper Creek Watersheds. Other past and reasonably foreseeable actions other than those described in the Cooper Creek Project would have no measurable effects.

The high basal area and level of ground disturbance within small drainages and sub-watersheds does increase the risk of increased sediment delivery from the aggregate of proposed actions. The roads that are located within streamside buffers in the Bryant Creek sub-watershed also add to the potential for increased sediment. Implementation of best management practices during and post treatment helps reduce this risk.

Use of herbicides although dependent on the extent of application would likely increase water yield. Herbicide used as a follow up treatment would extend the duration of increased water yield in a stand. Repeated entry from prescribed burns in the same drainages, particularly the same stands could also intensify effects.

Anion and cation solubility and mobility is affected by water. Increased water yield coupled with decaying or combusted material could accelerate dissolved nutrient leaching and loss via stream flow.

Nitrogen and phosphorus have been studied most extensively and while short-term increases are often seen, the increased levels are not considered high enough to impair water quality downstream. Sulfate is less studied, but is generally found to be less mobile. Increased sulfate concentrations from vegetation treatments are of interest because of gradually increasing concentrations of sulfate with low ANC values in the Southern Appalachian Mountains. While existing studies indicate a low risk to stream, the predicted change is unknown.

Water temperature is an existing concern because of increasing temperatures from climate change and risk of increased water temperature resulting from loss of hemlocks. Shade along streams would be protected through implementation of BMP including SMZ corridors. An increase in water yield would likely help to keep water cool despite higher air temperatures. Reduction of large areas of vegetation, especially overstory removal could alter micro climates and warm soils, thereby warming water temperature.

Cumulative watershed effects (CWE) from prescribed burns would be of short duration, localized, and of low magnitude. Cumulative effects to water resources from road maintenance, reconstruction, and utilization of temporary roads would likely result in short term localized increases in sediment. Increases in water yield from silvicultural treatments would likely result for several years, but would be diluted in lower Cooper Creek, and likely not be detected once reaching Toccoa River. The effects of increased water yield would likely be neutral or positive for aquatic resources. Increased sediment from silviculture treatments, but design criteria would minimize the risk of effects being of magnitude and extent to impact beneficial uses. Effects to water chemistry are possible, but considered unlikely to be detectable or of significance.

The greatest concerns to water resources come from effects of climate change, loss of hemlocks from HWA, and long term acidic deposition. The ability to address these issues extends beyond the scope of this document; however, a primary objective of the Cooper Creek Watershed Project is to improve forest health and ecological resilience. Achievement of these objectives may result in benefits to water resources.

3.5 Air

3.5.1 Affected Environment

Air pollution is the presence of one or more contaminants released into the atmosphere with a concentration and duration known to be hazardous to human health or welfare (Sandberg et al. 1999). Air quality is a measure of the presence of air pollution. The Clean Air Act applies to ambient air quality where people have access outside of industrial site boundaries. National ambient air quality standards (NAAQS) are in place to protect human health or welfare for six criteria pollutants. Although the proposed Cooper Creek Watershed Project includes a variety of management actions, not all proposed activities result in significant air pollution emissions. In addition, acid deposition in combination with timber harvesting decreases the amount of available soil base cations. Discussion of the potential impact of base cation reductions occurs in the Soils section above (3.3). Thus, this air analysis will only focus on the one proposed management activity, prescribed burning, that results in a significant increase in air emissions.

Emissions from wildland fire include carbon dioxide, water, carbon monoxide, particulate matter, hydrocarbons or volatile organic compounds, and nitrogen oxides. Carbon monoxide is the most abundant air pollutant emitted from wildland fires. It is of concern to human health, because it binds to

hemoglobin in place of oxygen and leads to oxygen deprivation and all of the associated symptoms. These symptoms include diminished work capacity to nausea, headaches, and loss of mental acuity. Carbon monoxide concentrations can be quite high within the burn unit, but they decrease rapidly downwind in cleaner air. Carbon monoxide exposure can be significant for those working the line of a prescribed fire. Due to rapid dilution, carbon monoxide is not a concern to urban and rural areas even a short distance downwind from the prescribed fire.

Nitrogen oxide (NO_x) emissions from wildland fires are low, and hydrocarbon emissions are moderate. Alone they are not very important to human health, but they are precursors to the criteria pollutant, ozone. Ozone forms in the atmosphere when nitrogen oxides and hydrocarbons combine in the presence of sunlight. Fire-related NO_x and hydrocarbon emissions become more important to ozone levels only when other persistent and much larger pollution sources already present a substantial base load of precursors. The most important pollutant from wildland fire emissions is fine particulate matter ($PM_{2.5}$) due to the amount emitted and the effects on human health and visibility (Hardy et al. 2001). The term fine particulate refers to particulate matter 2.5 microns or less in diameter.

The criteria pollutants of most concern on the Chattahoochee-Oconee National Forests are fine particulate matter and ozone. Fine particulate matter is the leading cause of regional haze (also known as visibility impairment), while ozone can harm sensitive vegetation within the forest. Additionally, at elevated concentrations these two pollutants can impair the health of both employees of and visitors to the National Forests, and nearby communities. Although air regulators monitor ozone and fine particulate matter at many locations, there are few monitors located near the Proposed Action. There is just one ozone monitor within 50 kilometers of the proposed controlled burning units. For fine particulate matter, there are no nearby monitors measuring if there is an exceedance of the NAAQS. However, there is a regional haze visibility monitor near Cohutta Wilderness and it does have estimates of the fine particulate concentrations.

At the nearby ozone monitor, the 2012-2014 average ozone concentration was below the national ambient air quality standard (NAAQS) set by EPA in October 2015 (Figure 3.5.1). The NAAQS for fine particulate matter ambient has two averaging periods – an annual and daily. The reconstructed fine particulate matter results at the Cohutta Wilderness monitoring site have been less than the daily NAAQS of 35 micrograms per cubic meter since 2008 (Figure 3.5.2).

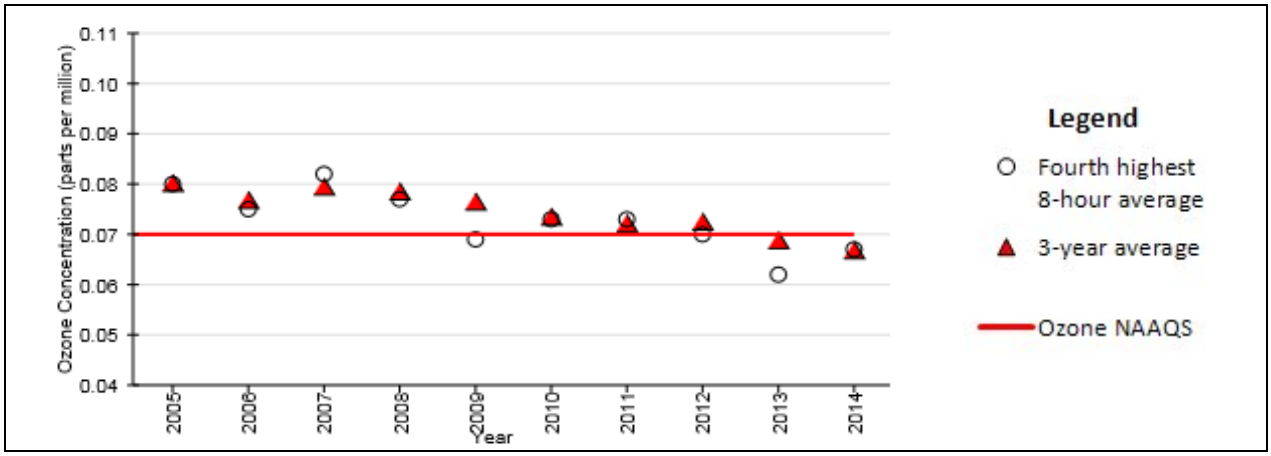

Figure 3.5.1 Murray County, Georgia ambient ozone monitoring results. Taken from: http://webcam.srs.fs.fed.us/graphs/o3calc/health.php?state=13&county=213&siteid=00031.

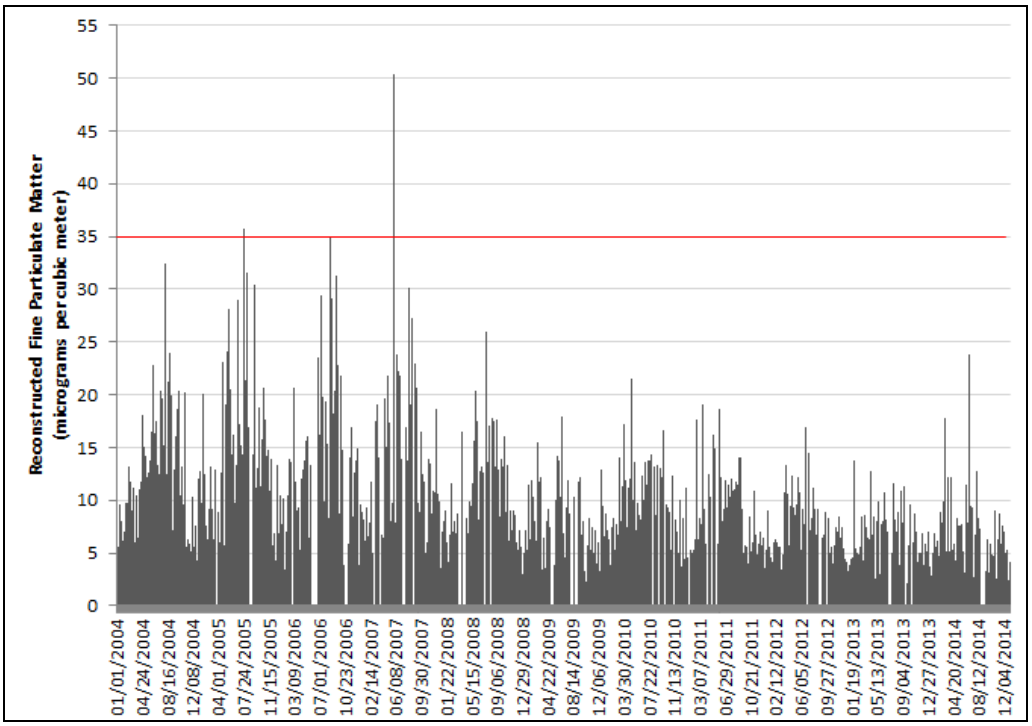

Figure 3.5.2. Fine particulate matter monitoring results as compared to the daily NAAQS. The daily standard is exceeded if the three-year average of the 98th percentile value is greater than 35 µg/m^3. Data source: http://views.cira.colostate.edu/fed/ToolsMenu.aspx.

While air quality monitoring describes ambient pollution levels, emissions inventories provide information on the contribution of various pollution sources to total emissions for specific geographic areas. Emissions from prescribed fires are unlikely to be a significant contributor to ozone. In much of the rural South, ozone formation tends to be NO_x-limited and prescribed fires are usually not a major NO_x source when compared to others, such as vehicles. In addition, the amount of NO_x and VOC from forestry activities is small compared to other sources. Most importantly, weather and climate conditions in this area tend to preclude prescribed burning from becoming a significant contributor to ozone formation. Most ozone events occur in mid-spring through late summer when hot temperatures and high-pressure air masses may stagnate over an area, and there is a lack of pollution dispersal. Typically, under these types of weather conditions no prescribed burning occurs because of the smoke dispersion issues.

Conversely, the fine particulate matter emitted from prescribed fires is a contributor to ambient levels of this pollutant. Table 3.5.1 shows the total fine particulate matter emissions in the county where burning is proposed, as well as the emissions from prescribed burning, based on EPA's most recent National Emissions Inventory. Since the Forest is the primary prescribed burner in the analysis area, it is easy to see the contribution of these emissions to overall fine particulate emissions. In 2011, prescribed fire emissions accounted for 3.3 percent of all fine particulate emissions within the county where burning is proposed. In the counties within 40 miles of the proposed project, prescribed fire emissions accounted for 1.8 percent of all fine particulate matter emissions. Other sources of fine particulate emissions include fuel combustion and operations at industrial facilities, waste disposal and recycling operations, construction, and agricultural activities.

Table 3.5.1: Fine particulate emissions (in tons per year) from the 2011 EPA National Emissions Inventory. Source: http://www.epa.gov/ttnchie1/trends/ and ftp://ftp.epa.gov/EmisInventory/2011/2011neiv1_eventfire_countyscc_caphap.zip

	Fine Particulate Emissions in Tons per Year		
Geographic Area	**From All Sources**	**From Prescribed Fires Only**	**Percentage of Prescribed Fire Emissions to All Emissions**
Within Union County, GA	4182	138	3.3%
Counties Within 40 Miles of Proposed Project	96,105	1722	1.8%

All prescribed burning activities on the Chattahoochee-Oconee National Forests must follow the Region 8 Smoke Management Guidelines in order to alleviate the smoke related impacts. Smoke management planning in accordance with the Region 8 Smoke Management Guidelines has been successful in protecting health and safety during past activities. The Guidelines require that smoke dispersion modeling be used during the prescribed fire plan development for all burn units that will consume more than four tons per acre and/or an active fire of 180 acres or more to ensure that the smoke management objectives previously set forth are met. If modeling shows potential impacts, then adjustments to the burn plan or mitigations on the day of the burn will be necessary in order to go forward with the burn. Each burn unit is planned in accordance with the Guidelines such that specific parameters are met, including mixing heights, wind speeds and directions. While a few of the larger units have the potential to transport smoke towards people, potential impacts will be mitigated by burning with a wind direction away from the people and other smoke sensitive targets.

3.5.2 Effects on Air

Measure: The amount of fine particulate matter released into the atmosphere.

***Bounds of Analysis*:** Within the area containing the proposed prescribed burning.

Alternative 1: No Action

Direct and Indirect Effects

This alternative would continue to have prescribed fires in areas where there is already an approval for dormant season burning. The alternative (as well as alternatives 2 and 3) would treat a total of 11,842 acres with prescribed fire, but only 80% of those acres will burn (9500 acres). The Consume model (version 4.2) estimated 8.28 tons per acre of fuel consumption for a total of 78,657 tons from the proposed units. The prescribed fires will release into the atmosphere fine particulate matter, non-methane hydrocarbons (volatile organic compounds), methane and carbon dioxide emissions of approximately 535, 248, 248, and 130,639 tons, respectively. If we assume all of the fine particulate matter emissions listed in Table 3.5.1 are from prescribed fires ignited by the USDA Forest Service then this proposed actions will increase fine particulate matter emissions by 397 tons per year in Union County, GA.

Cumulative Effects

The prescribed fires will release air pollution into the atmosphere, but the amount released will vary when burning occurs on different days. There is a possibility that annual fine particulate matter emissions could increase some years in the county (Table 3.5.1). Though there may be increases from fine particulate matter emissions, the air quality is likely to be good enough to protect people's health based upon a daily average. One reason is the continued reduction of fine particulate matter concentrations of sulfates in the atmosphere. Typically, the sulfates (fine particles) originated as sulfur dioxide (a gas) emissions from coal-fired power plants. Continued decreases in sulfur dioxide emissions are likely in the future.

Alternative 2: Proposed Action

Direct and Indirect Effects

Same as Alternative 1. Emissions of fine particulate matter should not change if the prescribed fire is conducted during the growing season, unless the fuel consumption is greater than 8.23 tons per acre.

Cumulative Effects

Same as Alternative 1.

Alternative 3

Direct and Indirect Effects

Same as Alternative 2.

Cumulative Effects

Same as Alternative 2.

3.6 Climate Change

3.6.1 Affected Environment

Atmospheric levels of greenhouse gases (GHG), including carbon dioxide (CO2) have increased over the last century due to increased burning of fossil fuels and land-use conversions (Ryan et al. 2010). Elevated levels of CO2 in the atmosphere have increased global surface temperatures and are expected to alter climatic patterns in the future. In northeast Georgia and the Blue Ridge Mountains, climate change models indicate significant increases in air temperatures from historic and current levels. Precipitation patterns are predicted to be relatively stable, averaging slightly less to slightly above current conditions (Keyser et al. 2014, TACCIMO 2014). Although the magnitude and temporal and spatial distribution of climate change are uncertain, all indications suggest that some change is certain. Predicted changes in regional climate could affect forest productivity (both positively and negatively) and intensify disturbance events, including weather disturbances (droughts, storm intensities), insect and disease outbreaks, and wildfires.

3.6.2 Effects on Climate Change

Measure: Measure will consist of effects of climate change on vegetation communities in the analysis area and the effects of proposed projects on climate change.

***Bounds of Analysis*: Spatial:** The Cooper Creek watershed is approximately 25,300 acres in size (approximately 23,445 acres National Forest / 1,855 acres private), the Coosa Creek watershed is approximately 14,342 acres in size (approximately 6,386 acres National Forest / 7,956 acres private), and the Youngcane Creek watershed is approximately 20,759 acres in size (approximately 4,187 acres National Forest / 16,572 acres private). **Temporal:** Approximately 10 years following implementation.

Alternative 1: No Action

Direct and Indirect Effects

In general, no changes to current trends in carbon storage and release in the analysis area would occur. Current forest conditions would be unchanged and less resilient to climate change impacts, including more severe disturbances (drought, insect and disease outbreaks, and wildfires). It should be noted that the planned dormant season prescribed burning would continue under the no action alternative and that the effects on carbon storage would be similar to those evaluated in the effects analysis for the action alternatives (see Alternative 2).

Cumulative Effects

Because no activities are proposed under this alternative, there would be no effects that could be combined with past, present, or reasonably foreseeable future actions that could cause adverse cumulative effects to climate change or its impacts on vegetation in the analysis area.

Alternative 2 – Proposed Action

Direct and Indirect Effects

The effects of treatments proposed under Alternative 2 on altering the impacts of climate change on the forest communities in the analysis area are uncertain; however, proposed management actions are compatible with adaptation strategies recommended for responding to potential impacts associated with climate change. Forest management actions that improve the ecosystem's resilience and resistance to climate-driven disturbances and that emphasize structural and age-class diversity have been recommended as strategies for adapting to predicted climate change patterns (Bernazzani et al. 2012; Joyce et al. 2009).

- Climate change is expected to intensify forest pest epidemics and expand ranges of some forest pests as temperatures increase (Keyser et al. 2014). Drought conditions are also expected to be more frequent as climate patterns change. This project includes proposals to thin forest stands to improve forest health, structure and function. Thinning stands reduces competition among trees for site resources (sunlight, water and nutrients) and improves stand and tree level health. Healthy stands are more resistant to forest pest epidemics and more tolerant of drought.

- This project also includes intermediate thinning treatments for white pine/oak maintenance and open woodland restoration. These treatments would also reduce tree density and free up site resources for residual trees, making stands more healthy and resistant/tolerant of pest epidemics and drought. Predicted increases in drought conditions and pest epidemics associated with climate change in the southeast are also expected to increase frequency and

severity of wildfires due to fuel accumulations and drier conditions. Maintenance and woodland restoration treatments include prescribed burning to reduce fire-intolerant species (white pine) and to restore historic stand structure and composition. These actions would reduce the potential for uncharacteristic fire severity while restoring communities more adapted to fire disturbances.

- The oak community in the analysis area is dominated by closed canopy forests. Due to site and age relationships, many mature oak stands are at risk of oak decline. Predicted increases in temperature and longer periods of drought conditions due to climate change could result in greater incidence of oak decline as well as expansion of the current range of gypsy moth further south (Keyser et al. 2014). Thinning and other intermediate stand- management activities could promote resilience to future oak decline.

- Climate change is expected to increase wildfire frequency due to drier conditions and fuel accumulations resulting from pest epidemics. Restoration of these areas to a more fire-dependent community would improve the resiliency of the forest to an increase in fire frequency expected from climate change.

- Climate change will likely both increase the rate of invasion of invasive plants and likelihood of species into new ecosystems (Keyser et al. 2014). Improving resilience of the forest ecosystems and understory diversity may reduce the risk of invasion and spread of invasive plants.

Forests play a major role in the carbon cycle. The carbon stored in live biomass, dead plant material, and forest soils can offset concentrations of CO2 emitted into the atmosphere.

Additionally, forest and wood products contribute to carbon storage. In the U.S., forests and forest products have sequestered the equivalent of 10 to 19 percent of the nation's CO2 emissions from burning fossil fuels during the last decade (Birdsey et al. 2006, Ryan et al. 2010, U.S. EPA 2012). The impact of disturbance on forest carbon stocks depends on the forest type (Vanderberg et al. 2011).

The proposed action includes timber harvesting and prescribed burning to meet multiple resource objectives. This action would temporarily reduce carbon storage in the analysis area; however, forest land-use and forestry practices continue to be a net carbon "sink," with carbon storage gains exceeding carbon losses (U.S. EPA 2012).

Thinning and other intermediate treatments would also remove trees from proposed stands, decreasing carbon storage of live above ground biomass. Losses would be temporary (as short as one year (Chiang et al. 2008)), as leaf area and net primary production of residual vegetation increase. Utilization of wood products removed during thinning would partially offset initial carbon losses. Thinning treatments would improve tree/stand vigor and decrease insect and disease threats while reducing fuel accumulations. These actions could increase tree survival following severe wildfires (Osborne et al. 2010) or during pest epidemics, thereby reducing further carbon losses associated with mass mortality. Net carbon benefits from thinning, however are still debatable, and more research is needed (Ryan et al. 2010). Time periods for recovery would depend on the rate at which vegetation re-establishes, growth rates of the vegetation, and frequency/severity of future disturbances. Predicted

increases in disturbances related to climate change could interrupt recovery periods. Maintaining healthy forests by restoring fire-adapted communities and improving age-class structure could minimize impacts of climate change-driven disturbances predicted in the future.

Prescribed fire treatments are proposed over the next decade to restore/maintain xeric upland communities in the analysis area. These treatments would result in short-term release of carbon into the atmosphere by combusting leaf litter and other dead plant materials. Understory vegetation killed during fires would decompose, and also contribute to carbon emissions.
Prescribed fire would also reduce fuels and increase forest health. These actions could reduce greater carbon losses associated with increases in wildfire severity due to predicted climate change (Osborne et al. 2010). However, the net carbon benefits of fuel reduction treatments, including prescribed fire and thinning, are not completely understood (Ryan et al. 2010).

Prescribed burns would be applied under site specific ignition plans with weather specific parameters resulting in low to moderate intensity fires. Aboveground live biomass losses would be insignificant, with little or no affect to forest carbon uptake (Chiang et al. 2008). Low to moderate intensity fires consume only upper organic soil layers (leaf litter), typically leaving duff, humus and organic matter in upper mineral soil horizons intact. Effects to soil organic matter and soil carbon are minor and of short duration under low severity fires (Neary et al. 2005). Additionally, Leichty et al. (2005) found that short-interval prescribed fire applied in fire-adapted shortleaf pine ecosystems increased soil carbon concentrations over a 17-21 year period. Increases were contributed to herbaceous vegetation response and contributions from dead woody debris.

The impacts of the proposed action on global carbon sequestration and atmospheric concentrations of CO2 are miniscule. Forest and forest products currently serve as a major carbon sink, offsetting 10 percent or more of the nation's CO2 emissions. Predicted changes in climate patterns and associated increases in frequency and intensity of disturbances have the potential to reduce the carbon sequestration capacity of our forests. Forests that are more resilient to climate change impacts could help sustain carbon storage potential. Proposed activities included in this action alternative would make the forest more resilient and resistant to predicted climate change impacts.

Cumulative Effects

Actions under this alternative that would affect climate change would include timber harvesting and prescribed burning activities. These activities would improve forest health, restore and maintain fire-adapted communities, provide structural and age-class diversity, and reduce fuels. These actions would also reduce existing above ground carbon stocks in the analysis area, but could improve resilience and resistance characteristics in response to predicted climate change patterns/disturbances. These effects represent the trade-offs associated with mitigation strategies designed to increase carbon storage and adaptation strategies designed to condition forests for changing environmental conditions (D'Amato 2011, Evans et al. 2009).

Past, present, and reasonably foreseeable activities potentially effecting climate change or its impacts on forest vegetation in the analysis area includes approximately 9,693 acres of prescribed burning that has occurred during the last decade. Effects of this burning would be similar to those described above for prescribed burning proposed under this action alternative.

The effects of this action alternative when combined with past, present, or reasonably foreseeable actions on the global carbon cycle are extremely small. Carbon storage would be reduced temporarily, increasing carbon emissions; however, proposed treatments would increase the resilience and resistance of the areas from predicted climate change impacts.

Alternative 3

Direct and Indirect Effects

The effects of this alternative on climate change is expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects

Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

3.7 Major Forest Communities

3.7.1 Affected Environment

The vegetation within the Cooper Creek Watershed has been analyzed and characterized through the use of the Cooper Creek Ecological Classification System (ECS), site specific stand exams and Light Detecting and Ranging satellite imagery (LiDAR). These data were used to characterize and quantify the current condition of the major forest communities found within the watershed, and then to make comparisons of the current conditions of the vegetation versus the desired or "reference" conditions of the vegetation. Ecological departure is defined as the difference between the current condition and the reference condition for specific forest vegetation types. Details of the Cooper Creek ECS and Departure Analysis can be found in Appendix C and D, respectively.

Description of Analysis

The Cooper Creek ECS system was developed through a spatial analysis of landscape variables to produce a map of potential vegetation for the area. The dominant ecological systems within the Cooper Creek Watershed include: Acidic Cove, Rich Cove, Northern Hardwoods, Oak Forest Transition to Cove, Dry-Mesic Oak Forest, Dry-Xeric Oak Forest, and Montane Oak. Table 3.7.1 illustrates the types of ecological systems and the corresponding acreages associated with each found in the Cooper Creek Watershed.

Table 3.7.1 Type and acreages of the Cooper Creek Watershed major ecological systems.

Ecological System	Approximate Acres	Percent of Project Area
Acidic Cove	3,891	13.1%
Rich Cove	3,139	10.6%
Northern Hardwoods	68	0.2%

Oak Forest Transition to Cove	3,912	13.2%
Dry-Mesic Oak Forest	5,854	19.8%
Dry-Xeric Oak Forest	11,513	38.9%
Montane Oak Forest	1,248	4.2%
Totals	29,625	100%

Due to data availability, the total acreage modeled is slightly different from the total actual acreage of the watershed.

The Cooper Creek Watershed is a diverse project area that is fairly balanced across the 7 ecological systems. Dry – Xeric Oak Forest Type covers the largest amount of acreage at 11,513 acres and almost 40% of the analysis area, Northern Hardwoods and Montane Oak Forest account together for only approximately 4.6% while the remaining 4 ecological systems range from 10 – 20% of the project area each.

Duncan Ridge is the major terrain feature within the project area affecting the ecological systems. Most all of the Rich Cove systems are found north of Duncan Ridge on the more northern aspects while the majority of the Dry – Xeric Oak Forest along the with the Acidic Cove Forest systems are found on the more southern aspects south of Duncan Ridge. The Dry – Mesic Oak Forest and the Oak Forest Transition to Cove Forest systems are fairly evenly distributed on the north and south sides of Duncan Ridge.

As discussed above, ecological departure is defined as the difference between the current condition and the reference condition for specific forest vegetation types. The results of the ecological departure analysis for the Cooper Creek Watershed are shown in the following table. This departure analysis was one of the analysis tools used to develop the Alternatives and the locations of the treatments.

Table 3.7.2. Ecological Departure Analysis.

Ecological System	Departure*	Driver of Departure
Acidic Cove	56%	Lacks early-seral, lacks old growth
Rich Cove	57%	Lacks early-seral, lacks old growth
Northern Hardwoods	33%	Lacks early-seral, too much closed canopy
Oak Forest Transition to Cove	69%	Lacks early-seral, lacks old growth, too much closed canopy, too much white pine
Dry – Mesic Oak Forest	72%	Lacks early-seral, lacks old growth, too much closed canopy, too much white pine
Dry – Xeric Oak Forest	83%	Lacks early-seral, lacks old growth, too much closed canopy, too much white pine
Montane Oak Forest	65%	Lacks early-seral, lacks old growth, too much closed canopy, too much white pine

*0-33% = minimally departed, 34-66% = moderately departed, and 67-100% = highly departed.

From the analysis, the following trends can be observed:

- approximately 72% of the project area (Oak Forest Transition to Cove, Dry – Mesic Oak Forest, and Dry – Xeric Oak Forest systems) was found to be highly departed
- a main source of departure for all ecological systems was the lack of early-seral habitat

- old growth is lacking across all ecological systems
- white pine is dominating or co-dominating sites where historically it did not occur; this is true across all the oak ecological systems
- less than 1% of project area is in an early – seral condition
- approximately 88% of the project area is currently in a closed canopy condition

Site-specific stand exams conducted by Forest Service personnel supplement this data by providing information regarding the existing species composition of forest communities within the watershed. Existing forest communities within the Cooper Creek Watershed are dominated by mixed red and white oaks, white pine, yellow poplar and red maple. Although white pine is native to the Cooper Creek Watershed and largely in the Acidic Cove ecological system, it is currently found throughout the various oak forest systems (with the exception of Montane Oak Forest system). Approximately 22% of the upland oak sites are currently dominated by white pine. The aggressive nature of white pine can prohibit the establishment of the native oak species.

Table 3.7.3. Forest Type Distribution for the Cooper Creek Project Area.

Forest Type	Acres	Percent of Project
Non-Forest/No FS Veg Data	236.58	0.80
White Pine	6,512.74	21.98
Hemlock	11.72	0.04
Hemlock-Hardwood	25.84	0.09
White Pine-Cove Hardwood	522.73	1.76
White Pine-Upland Hardwood	2,211.66	7.47
Shortleaf Pine-Oak	21.60	0.07
Virginia Pine-Oak	47.87	0.16
Loblolly Pine	17.64	0.06
Shortleaf Pine	56.87	0.19
Virginia Pine	54.19	0.18
Cove Hardwood-White Pine-Hemlock	308.89	1.04
Upland Hardwoods-White Pine	1,376.62	4.65
Chestnut Oak-Scarlet Oak-Yellow Pine	194.68	0.66
White Oak-Black Oak-Yellow Pine	11.83	0.04
Northern Red Oak-Hickory-Yellow Pine	49.94	0.17
Yellow Poplar	437.70	1.48
Chestnut Oak	194.22	0.66
White Oak-Northern Red Oak-Hickory	12,536.66	42.32
Yellow Poplar-White Oak-Northern Red Oak	4,550.40	15.36
Scarlet oak	30.11	0.10
Chestnut Oak-Scarlet Oak	198.47	0.67
Black Ash-American Elm-Red Maple	16.63	0.06

3.7.2 Effects on Major Forest Communities

Measure: Measure will consist of effects of alternatives on forest species composition, successional stage distribution, and forest structure
***Bound of Analysis*: Spatial:** approximately 60,371 acres of total acreage, 34,018 acres of National Forest land and 26,353 acres of Privately Owned land, **Temporal:** Approximately 10 years following implementation.

Alternative 1: No Action
Direct and Indirect Effects – This alternative would provide a very limited scope of vegetation management. Most would occur through the prescribed burning treatment during the dormant season that is approved under previous decisions.

Prescribed Fire proposed on 11,842 acres. These control burns would be implemented by hand and/or aerial ignition methods on a landscape scale, with the desired goal of a mosaic burn pattern. High to moderate fire intensities are desired for the south and west-facing xeric ridges, with moderate intensity fire on the midslopes. Low intensity backing fires will be used adjacent to trails and in riparian areas and mesic hardwood stands, allowing the fire to burn naturally. A site-specific burn plan would be prepared for each burn unit. This plan will describe the weather and fuel conditions under which the burn could be safely executed and consider the effects of the fire on other resources, including smoke impacts. All bladed dozer lines used to contain the burns would be re-vegetated and meet best management practices, after the burn is conducted, using a non-invasive grass mixture that is best suited to the area, time of year and benefit to wildlife. The preferred fire lines will consist of existing roads, streams, and constructed hand line while limiting and reducing the amount of bladed dozer line.

Burning would take place during both the dormant and growing season to achieve the desired fire conditions. The dormant season is defined as approximately November 1st through April 15th, with the primary implementation period being February through March. The growing season is approximately April 16th through October 30th, with the preferred time being April 16th through May. After initial treatments, a 3-5 year prescribed fire rotation is expected to be necessary to continually maintain the desired conditions. Project level vegetation monitoring will be used to determine exactly when and how many prescribed burns are needed to maintain the fire adapted habitats within these burn units.

Cumulative Effects

Treatments under this no action alternative will be carried out though previous decisions for dormant season only prescribed burns. Cumulative effects would include some understory vegetation control as the prescribed burn units are treated through multiple rotations. Over time, some canopy gaps may be created through natural tree mortality. This will be isolated and in small patches and will not provide any ESFH of any scale. Sites will continue to be heavy closed canopy. White pine will continue to dominate on more xeric sites where historically white pine was uncharacteristic and prevent the restoration of native oaks which would have historically occupied the sites. White pine also would potentially encroach into other sites historically occupied by oaks. Over time, stands will continue to age and could increase old growth characteristics.

Alternative 2: Proposed Action

Direct and Indirect Effects – The activities included within the Proposed Action Alternative which would have an effect on the major forest communities found within the Cooper Creek Watershed include: 1) Oak/Oak-Pine Thinning, 2) Pine/Pine-Oak Thinning, 3) Canopy Gap Thinning, 4) Early Successional Forest Habitat, 5) Woodland Restoration, 6) Midstory Treatment, 7) Release, 8) and Prescribed Fire.

Oak/Oak-Pine Thinning proposed on 112 acres. The purpose of the treatment is to encourage oak regeneration and improve the health and vigor of these stands. Additional benefits, such as increased herbaceous understory, may also be achieved. Residual BA may vary with each stand, but will range from 60 -80 square feet per acre. One of the objectives is to restore and sustain the more desirable white and red oak species, therefore those species will be high priority for retention. Most of these stands are on north facing aspects that are dominated by chestnut oak with declining white and northern red oak populations.

This treatment would improve overall tree health and vigor in theses dense, overstocked stands by reducing the competition. The resulting stands will have fewer trees per acre than current levels and that will provide improved open growing space for natural oak regeneration.

Pine/Pine-Oak Thinning proposed on 843 acres. The purpose of the treatment is to reduce the basal area (BA) of these stands by focusing on commercial white pine thinning using ground based equipment. Other undesirable species such as yellow poplar and red maple may be removed and may require herbicide treatment to prevent stump sprouts. These treatments will improve the health and vigor of the stands and will release desirable oak species, thus restoring oak to its native sites. In those stands where sufficient oak regeneration is not present, thinning will allow sunlight to reach the forest floor stimulating oak regeneration over time. Residual BA for thinning may vary with each stand but will range from 60-80 square feet per acre.

This treatment would improve overall tree health and vigor in theses dense, overstocked stands by reducing the competition. The resulting stands will have fewer trees per acre than current levels and that will provide improved open growing space for natural oak regeneration.
This treatment will also improve habitat conditions as it will begin to transition the stands back to species composition which would have historically occupied the sites. This will include thinning and maintaining white pine in the acidic coves where it naturally would occur and removing white pine to promote more oak species on sites that were historically oak-dominated (oak transition to cove forest and dry – mesic oak forest).

Canopy Gap Thinning proposed on 466 acres. The primary purpose of canopy gap thinning is to increase structural diversity in mesic hardwood stands to enhance habitat for bird species. In addition, the reduction in BA will allow sunlight to reach the forest floor stimulating oak regeneration. The stands are mostly mid-successional mature mesic hardwood stands consisting of yellow poplar, chestnut oak, white oak, northern red oak, and hickory. White pine is a minor component in a few of the stands and chestnut oak is abundant. Stands are overstocked with closed canopies. Residual basal area (BA) may vary with each stand, but will range from 60-80 square feet per acre. The dominant trees in these stands will be selected for retention and will include oaks and other soft and hard mast producing species.

This treatment will improve structural diversity across the project area and provide a patchwork of early successional habitat that will provide enhanced habitat for a variety of wildlife species. It will also improve the overall stand health by reducing competition through thinning thus improving the growing condition and oak regeneration conditions on 466 acres.

Early Successional Forest Habitat proposed on 253 acres. The primary purpose of regenerating these stands is to improve habitat conditions for species such as ruffed grouse and other early successional species. Secondary objectives include restoration of oak on sites where white pine is dominating but not ecologically appropriate and oak maintenance in existing oak stands. Stands will be harvested with a two-aged with reserves method, retaining approximately 20 square feet of basal area (BA) of overstory trees per acre. Stands may require post-harvest release treatments (chemical, mechanical and/or burning) to reduce competition from undesirable species. Following harvest, the white pine stands will require site preparation treatments, planting of native oak species, and subsequent release treatments. Site preparation treatments may include chemical and/or non-chemical methods such as prescribed burning.

This treatment, while on less than 1% of the project area, will improve forest habitat by providing essential early successional forest habitat to an area where it is critically lacking (refer to Table 3.7.2), This habitat is critical to various wildlife species including ruffed grouse, various other bird species, and white tail deer. In addition, this treatment will also improve forest habitat by restoring tree species to their native sites by removing white pine from sites where oak should be present.

Woodland Restoration proposed on 764 acres. The purpose of this treatment is to increase the amount of open canopy oak and pine forests. The stands proposed for woodland restoration have been separated into two categories by the treatment type, commercial (641 acres) and non-commercial (123 acres). To achieve the desired woodland condition, the density of the stands will need to be reduced to less than 60 square feet per acre of basal area (BA). However, the degree of basal area reduction will vary within these stands depending on site conditions. On the dry ridges (xeric to subxeric) within these stands, overstory basal area (BA) will be reduced to 15 to 30 square feet per acre. Below the ridges on the subxeric slopes, residual BA will range from 30 to 60 square feet per acre. The more mesic portions of these stands will not be managed as woodland but will be thinned to 60-80 BA to enhance oak regeneration and improve forest health. Following harvest, these stands will be prescribed burned to control woody sprouting and encourage herbaceous development. Until the desired condition has been reached, burning intensity, frequency and seasonality will be guided by project-level monitoring. Species selected for retention would include fire tolerant hardwoods and yellow pines. Commercial thinning would be accomplished using ground based equipment. Post-harvest herbicide treatments may be necessary to encourage the dominance of herbaceous species, and reduce sprouting of undesirable hardwoods such as yellow poplar and red maple.

This treatment would restore oak woodland habitat to approximately 764 acres (excluding riparian areas) across the Cooper Creek project area (less than 3%). It will also improve forest conditions by providing patches of more open canopy forest, which is lacking across the project area as a whole (refer to Table 3.7.2).

Midstory Treatment proposed on 1056 acres. The purpose of the midstory treatment is to allow enough sunlight to the forest floor to stimulate new and existing oak regeneration while providing enough

shade to suppress shade intolerant species such as yellow poplar. The desired result is oak regeneration that is at least 4.5 feet tall in preparation for stand regeneration. The majority of these oak dominated stands are on north facing aspects (Compartments 398 and 399) where yellow poplar is very competitive, the remaining stands are on south facing aspects. Stands vary in the density of the midstory, but all have little to no oak regeneration, and where present it is in the seedling stage. This treatment would be accomplished by cutting trees manually with a chainsaw and/or using an herbicide treatment. In both cases, woody material will be left on site. To prevent undesirable shade intolerant species from regenerating, the overstory canopy should be left intact, and no more than 30% of the total basal area (BA) treated. Follow up treatments may be necessary.

This treatment will improve the sustainability and restoration of oak to areas where shade tolerant species are dominating the forest midstory and suppressing potential oak regeneration.

Release Treatment proposed on 260 acres. The purpose of this treatment is to promote oak establishment in stands that have become over populated with yellow poplar. These stands were regenerated between 1970 and 1990. They were harvested by complete overstory removal without ensuring the presence of advanced oak regeneration resulting in stands dominated by yellow poplar. However, oaks are present in sufficient quantity that a crop tree release would transition the stand into a more desirable oak dominated condition. The release would be accomplished with manual chainsaw felling and/or herbicide treatments, with woody material left on site. Only those trees competing with desirable oaks or other soft and hard mast producing species would be treated, and would most likely include red maple and yellow poplar.

This treatment will improve growing conditions of the oaks and assist in transitioning the stand to an appropriate species composition.

Prescribed Fire remaining on 11,842 acres: Under this alternative, this treatment would include approximately 11,842 acres of prescribed fire that would occur in either the dormant season (November 1 – April 15) or the growing season (April 16 – October 31). These prescribed burn units would be burned on a 3-5 yr rotational period. The main objective of using prescribed to maintain fire adapted forest communities. However, other purposes and benefits of these burns include: 1) enhancing habitat conditions for woodland obligate plant and animal species; 2) creating patches of early successional habitat for both game and non-game wildlife; 3) increase oak seedling establishment; 4) reduce undesirable white pine, red maple and yellow poplar encroachment; and 5) reduce hazardous fuel accumulations to make wildfires easier to control.

The prescribed burn units are focused on the drier south and west facing slopes. Through the use of both dormant and growing season burns, fire adapted species will be maintained and enhanced and less desirable species such as poplar and maple will become less dominant over time.

Cumulative Effects

All treatments combined include approximately 13,490 acres. There are the above mentioned 11,842 acres of prescribed fire treatment acres, along with approximately 3,754 acres of the remaining vegetation treatments mentioned, but only approximately 1,650 acres of that is not in a prescribed burn block. Prescribed burning combined with commercial and noncommercial vegetation management

treatments would to help move the forest communities toward the desired conditions identified in the Cooper Creek ECS.

Non-commercial treatments such as the midstory and release treatments will improve oak health, establishment, and diversity on sites historically dominated by oak, much of which is dominated or co-dominated by off-site yellow poplar. Approximately 764 acres of the watershed will be restored to a woodland condition, resembling more of what would have been found on the landscape historically on the dry xeric sites. Approximately 253 acres of the watershed will be commercially harvested to provide for early successional forest habitat, a habitat critical for various wildlife mammals and birds. The open canopy conditions will occur across the project area which addresses one of the main findings of the departure analysis.

Overall, the effects of this alternative, when compared against other past, present and reasonably foreseeable future actions, would have a beneficial cumulative effect by increasing canopy gaps, increasing successional diversity, and increasing the amount of restoration of fire adapted communities. A complete list of past, present, and reasonably foreseeable actions for the Cooper Creek Watershed can be found in Chapter 3.2.

Alternative 3

Direct and Indirect Effects – In regards to effects on major forest communities, this alternative differs from the Proposed action in that: 1) Oak/Oak-Pine Thinning reduces from 112 acres to 65 acres, 2) Pine/Pine-Oak Thinning reduces from 843 acres to 740 acres, 3) Canopy Gap Thinning reduces from 466 acres to 204 acres of which only 100 acres will be accomplished commercially, 4) Early Successional Forest Habitat reduces from 253 acres to 249 acres, 5) Woodland Restoration remains proposed on 764 acres of which commercially accomplished reduces from 641 acres to 525 acres and non-commercially accomplished increases from 123 acres to 239 acres, 6) Midstory Treatment reduces from 1056 acres to 358 acres, 7) Release reduces from 260 acres to 219 acres, 8) and Prescribed Fire remaining at 11,842 acres.

Table 3.7.4. Comparison of treatment acres by Alternative

	Alternative 1: No Action	Alternative 2: Proposed Action	Alternative 3
VEGETATION MANAGEMENT			
Commercial			
Oak/ Oak-Pine Thinning	0	112	101
Pine/Pine-Oak Thinning	0	843	740
Canopy Gap Thinning	0	466	100
Early Successional Forest Habitat	0	253	249
Woodland	0	641	489
Total Commercial	**0**	**2,315**	**1,679**
Non-Commercial			
Woodland	0	123	231
Canopy Gaps	0	0	104
Midstory	0	1.056	358
Release	0	260	219
Total		**1,439**	**912**
Prescribed Fire	**11,842**	**11,842**	**11,842**

Although the treatment acres are reduced in this Alternative as compared to Alternative 2, the overall effects on the forest species composition, successional stage distribution and forest structure in the watershed will be similar to Alternative 2.

Cumulative Effects

The cumulative effects of this alternative would be similar to Alternative 2.

3.8 Successional Stage Forests and Habitats

3.8.1 Affected Environment

Succession is an orderly progression of changes in forest community characteristics following disturbance, from early successional communities characterized by open conditions and ruderal species (pioneer species), to late successional communities characterized by closed conditions and competitive species (Odom and Barrett 2005, Odum 1969). As plant communities undergo succession, so do wildlife communities: some wildlife require early successional communities for habitat, while other wildlife require mid-or late successional habitats (Rankin and Herbert 2014). Successional stages of forests are the determining factor for presence, distribution, and abundance of a wide variety of wildlife (USDA Forest Service, 2004a).

Mid to late successional stage forests contain a number of required habitat attributes, including high canopy nesting, roosting and foraging habitats; large diameter trees suitable for cavity development; and sources of hard mast and seed (USDA Forest Service, 2004a). Late successional, closed canopy, stage habitat is the prevailing habitat condition in the Cooper Creek watershed. The Departure Analysis found that approximately 88% of the Cooper Creek watershed is comprised of closed canopy forest, with over 50% being consistent with the definition of late succession.

Early successional forest habitat (ESFH) is defined as regenerating forest of 0-10 years of age for all forest community types. It is characterized by dominance of woody growth of regenerating trees and shrubs, often with a grass/forb component, and relatively low density or absent overstory. Currently, early seral forests comprises less than 1 percent of the project area, the majority of which is in patches less than 1 acre in size.

Areas maintained as permanent openings such as open woodlands, savannas, grasslands, barrens and glades, balds, managed wildlife openings, old fields, pastures and rights-of-way do not qualify as ESFH (USDA Forest Service 2004a), but rather early successional habitat (ESH).

ESFH provides important habitat attributes for wildlife, including a diverse food source (forage, insect production, soft mast, and browse) and nesting and escape cover. These benefits only last a relatively short time and disappear as young forests develop and canopies close. A number of ESFH-dependent species have suffered decline due to the limited availability of this important habitat condition (Hunter et al. 1999). ESH provides similar wildlife value, but it is typically permanent on the landscape, and over time becomes dominated by grasses and forbs, rather than the woody growth of trees and shrubs which dominate ESFH. Many wildlife species in the Southern Appalachians use early successional

habitats to meet various biological needs, including foraging, hunting, nesting, rearing young, escape, thermoregulation, and protection from the elements (Dickson 2001). Other species use a variety of successional stages, but require early successional habitats during a particular biological season or time of year. Some wildlife species do not require early successional habitats, but are more abundant in these habitats. In general, their populations and individuals are healthier when a variety of successional stages are available (Fuller and DeStephano 2003) (Rankin and Herbert 2014).

The following table demonstrates the major ecological system and the current successional stage found.

Table 3.8.1. Current Successional Stage by Major Ecological System.

Successional Stage	Acidic Cove	Rich Cove	Northern Hdwds	Oak Forest-Transition to Cove*	Dry-Mesic Oak Forest*	Dry to Xeric Oak Forest*	Montane Oak Forest*	Total	Percent (%) of Project Area
Early	52.3	14.3	<0.1	16.2	32.7	109.3	3.4	228.1	0.8%
Mid - Open	0	0	0	225.6	232.4	669.4	15.2	1,142.5	3.9%
Mid - Closed	2,670.5	2,279.8	0.7	921.8	1,427.5	3605.4	271.0	11,176.8	37.7%
Late – Open	34.9	160.0	0.1	339.2	564.8	800.0	37.9	1,937.1	6.5%
Late-Closed	1,042.7	665.8	67.2	2,369.6	3537.5	6,244.1	920.7	14,847.5	50.1%
Wildlife Opening	29.7	2.2	0	2.5	7.1	28.3	0.1	69.8	0.2%
No Data	61.0	17.4	0	37.6	52.1	56.6	0	224.7	0.8%
Total	**3,890.9**	**3,139.4**	**68.0**	**3,912.4**	**5,854.4**	**11,513.1**	**1,248.3**	**29,626.6**	
	13.1%	**10.6%**	**0.2%**	**13.2%**	**19.8%**	**38.9%**	**4.2%**		
Early	0.8%			Fire Systems*		76.0%			
Mid	41.6%								
Late	56.6%								
Wildlife Opening	0.2%								
No Data	0.8%								
	100%								

*Fire Systems are associated with the following ecological systems; oak forest transition to cove, dry – mesic oak forest, dry to xeric oak forest, and montane oak forest.

3.8.2 Effects on Forest Successional Stages and Habitats

Measure- Measure will consist of effects on forest successional stage habitat abundance and distribution in the project area.

***Bound of Analysis*: Spatial:** approximately 60,371 acres of total acreage, 34,018 acres of National Forest land and 26,353 acres of Privately Owned land, **Temporal:** Approximately 10 years following implementation.

Alternative 1 – No Action

Direct and Indirect Effects – The no action alternative only includes prescribed burning on previously burned areas, covering 11,842 acres. In general, the ongoing dormant season prescribed burns are not expected to substantially increase the availability of early successional forests. Through time, the

amount of early successional habitat would decrease as these young forests mature. Overall, late stage successional forest with closed canopy would continue to dominate the landscape (ESC model).

Plant and animal species which depend on ESFH would continue to decline. Plant and animal species which depend on late successional forest would continue to thrive within the project area. The existing small pockets of young forest (approximately 228 acres) that has primarily been created and maintained through prescribed burning would grow older and lose its value as early successional habitat for wildlife species. As existing tree fall gaps grow older and close in, it can be assumed that new ones would form. However, based on current trends within the watershed, tree fall gaps are likely to occur at a much smaller scale than is needed for ESFH dependent wildlife species. Current total ESFH habitat comprises well under 1% of National Forest System land within the Cooper Creek watershed.

Cumulative Effects – This alternative, when combined with other similar "no management action" scenarios, would further contribute to the cumulative decline of the early successional forests and habitats found within the Cooper Creek Watershed and the southern Appalachian Mountains as a whole. However, under this Alternative, species requiring late successional forests/habitats would continue to increase. This alternative, when combined with other past, present and reasonably foreseeable future actions would have a negative cumulative effect on early successional dependent species, and a positive cumulative effect on late successional species. A complete list of past, present and reasonably foreseeable future actions for the Coopers Creek watershed can be found in Chapter 3.2.

Alternative 2 – Proposed Action

Direct and Indirect Effects - The activities included within the Proposed Action Alternative which would have a direct and indirect effect on early successional forests habitat found within the Cooper Creek watershed include: 1) Canopy Gap, 2) ESFH, 3) Woodland Restoration, and 4) Prescribed Burning. These individual treatments and the associated effects will be discussed separately below:

Canopy Gap Thin proposed on 466 acres. This treatment would increase the amount of small (one quarter to one half acre) gaps in the canopy across the stands and provide small pockets of ESFH while the stand as a whole continues to age and becomes more able to provide these gaps naturally.

Early Successional Forest Habitat proposed on 253 acres. This treatment would provide larger areas, 15-40 acres, of ESFH scattered throughout the project area. The majority of the ESFH are proposed within current prescribed burn blocks. However, some are proposed in non-prescribed burn blocks that will grow back naturally providing a thick underbrush for several years following treatment providing needed brush cover for various species of wildlife.

Woodland Restoration proposed on 764 acres. This treatment would open the canopy of oak and oak-pine stands and reduce tree density on 764 acres (excluding riparian areas) and restore woodland habitat on the dryer and more xeric sites. The proposed woodland restoration is to occur within current prescribed fire block that are to maintained by rotational prescribed fire on an approximate 5 year rotation. These areas would also provide habitat diversity across the landscape in the form of early successional grass/forb/shrub woodland habitat.

Prescribed fire Treatments are Proposed on 11,842 acres. This amount of treatment will occur in previously established burn blocks across the landscape. These burns will provide for the maintenance

of the created ESFH and the maintenance and restoration of ESH through the Woodland Restoration treatments.

Under this alternative, ESFH will increase immediately providing critical habitat for a variety of birds and other wildlife species largely due to the 259 acres of ESFH proposed as well as the 764 acres of woodland restoration proposed. This in conjunction with the prescribed burning already occurring as well the proposed growing season burns will help to maintain a portion of the ESFH as well as potentially provide additional small canopy gaps (< 2 acres in size) of ESH as a result of local fire mortality. The majority of the project area will continue to age providing additional late successional habitat.

Cumulative Effects - This alternative, when combined with other past, present and reasonably foreseeable future actions would not have a negative cumulative effect on early successional dependent species, nor a negative cumulative effect on late successional species. A complete list of past, present and reasonably foreseeable future actions for the Coopers Creek watershed can be found in Chapter 3.2.

Alternative 3

Direct and Indirect Effects - This alternative differs from the proposed action in that it would reduce the amount of canopy gap treatment from 466 acres down to 204 acres. In addition, Woodland Restoration Treatment is reduced from 764 acres down 720 acres. The reduction in acres is to focus this treatment on the most xeric sites within the watershed. The prescribed burning treatment will remain unchanged from Alternative 2 at 11,842 proposed acres of growing and dormant season burns.

ESFH treatment acres are essentially the same as in Alternative 2 (253acres to 249 acres). However the location of these treatments does change with more acreage focused on lower slopes and on the daylighting of existing woods roads that access established wildlife openings. In this Alternative, additional acres are located outside of prescribed burn units in order to provide unburned ESFH in appropriate sites. The stands proposed for ESFH have been ground surveyed to ensure no potential old growth stands are proposed for commercial ESFH.

Cumulative Effects - Although this alternative differs slightly from the proposed action in the amount of ESFH created, the difference in not considered to be significant enough to provide a difference in the cumulative effects already disclosed under Alternate 2, the Proposed Action section. The most significant change is the amount of ESFH created outside of the prescribed fire blocks that will be beneficial to multiple wildlife species by maintaining a heavier brush understory in pockets across the landscape.

3.9 Old Growth

3.9.1 Affected Environment

The following table (Table 3.9.1) represents Forest Plan Management Prescriptions and their compatibility with Old Growth Conservation.

Table 3.9.1. Forest Plan Management Prescriptions and Their Compatibility With Old Growth Conservation by Watershed

Management Prescriptions	Old Growth Compatible	Coosa Watershed Acres	Cooper Watershed Acres	Youngcane Watershed Acres	Total Acres
1.A Designated Wilderness	Yes		556		556
3.A Coosa Bald National Scenic Area	NO	828	3417		4245
4.A Appalachian Trail Corridor	NO		633		633
4.F Scenic Areas	NO		1,110		1,110
4.F.1 Scenic and Wildlife Mgt Areas	NO		27		27
4.F.2 Regional Forester Scenic Areas	NO		1,212		1,212
4.H Outstanding Remarkable Streams	NO		1,845		1,845
7.E.1 Dispersed Recreation Areas	NO	5,475	26	4,072	9,573
7.E.2 Dispersed Recreation Areas with Vegetation Management	NO	28	4,317	16	4,360
8.A.1 Mix of Successional Forest Habitats	NO		2,852		2,852
9.H Management, Maintenance, and Restoration of Plant Associations to Their Ecological Potential	NO	17	7,417	71	7,504
TOTALS		6,348	24,410	4,158	33,917

Wildlife habitat associated with old growth forests is rich in diversity due to the multiple canopy layers, "patchiness" of canopy caused by the death of single or multiple trees in small groups, standing dead and down dead trees and limbs, large diameter trees with cavities for denning and nesting, and many other habitat components at a variety of scales. Although there are no known wildlife species that are old-growth obligates in the southeastern United States, there are many species that are dependent upon late-successional forest habitats (of which old growth is an important component). Late successional habitat is plentiful in the Cooper Creek project analysis area although habitat currently designated as old growth is not.

To increase the amount of designated old growth on the Forest, in watersheds with more than 1,000 acres of National Forest land, at least 5 percent of each sixth-level HUC or sub- watersheds would be reserved as either existing or potential old growth (Forest Plan Objective 20.1). If less than 5 percent of the sub-watersheds is allocated to old growth or old growth- compatible management prescriptions, additional small blocks of future old growth would be identified and would be managed to protect their old-growth characteristics during the Plan cycle (Forest Plan Standard FW-044). In the Cooper Creek Watershed project analysis area (~29,465 acres), currently no acres are allocated to old growth.

The 3 Sixth Level HUCs in the Cooper Creek watershed project area (Cooper, Coosa, and Young Cane Creek Watersheds) all have sufficient Forest Service acreage (>1,000 acres FS) needed in order to reserve at least 5 percent for old growth potential (USDA Forest Service, 2004a). A total of

approximately 1,697 acres should be allocated to Old Growth management in the Project Area to meet Forest Plan requirements. Of that, 1,171 acres should be allocated in the Cooper Creek Watershed, 318 acres in the Coosa Creek Watershed, and 208 acres in the Young Cane Creek Watershed. There are no Old-Growth compatible Management Prescriptions in the Coosa Creek or Youngcane Creek Watersheds. The only old-growth compatible prescription in the project area is 1.A. Designated Wilderness. There are 540 acres of Wilderness in the Cooper Creek Watershed, therefore an additional 631 acres of future old-growth should be allocated for the Cooper Creek Watershed. Priority for representation would be given to areas managed for dry-xeric oak forest, woodland, savanna, dry – mesic oak forest, dry and dry – mesic oak – pine forest, followed by mixed mesophytic forest.

The Coopers Creek Watershed harbors a high percentage of Late Successional Forest that is approaching Old Growth minimum age requirements, which ranges from 110 – 140 years of age depending on the old growth community type. While it is likely that 130 years of age is too young to attain all old-growth characteristics, this age is consistent with the age threshold for many hardwood types in the Region 8 Guidance and there is evidence that by 160 years, some secondary hardwood forests have characteristics of old-growth (USDA 1997, Scheff 2012). Age is merely a starting point as there are other criteria that must be met in order to be designated as Old Growth.

The below Table, 3.9.3, demonstrates the acres of old growth potential within the project analysis area by old growth community type.

Table 3.9.3. Acres of potential old growth community types within project area that meet minimum age requirements by watershed.

Potential Old Growth Community Type	Cooper Creek	Coosa Creek	Young Cane Creek
02 Conifer / Northern Hardwood	130.2	-	20.1
05 Mixed Mesophytic Forest	-	42.7	140.7
21 Dry – Mesic Oak Forest	16.6		-
22 Dry –Xeric Oak Forest, Woodland, Savanna	1,480.8	343.7	835.3
24 Xeric Pine and Pine – Oak Forest, Woodland	-	11.9	55.1
25 Dry and Dry – Mesic Oak – Pine Forest	289.0	92.6	74.8
Total	**1,916.7**	**490.9**	**1,126.0**

The following table represents the priority areas that are currently proposed for old growth allocation in the project area to meet the minimum allocation requirement of 1,697acres. An approximate total of 1,834 acres is proposed for allocation to the Old Growth Management Prescription in the Project Area. These areas are allocated based primarily on examination of current forest stand data and guidance provided in the Forest Plan.

Table 3.9.4. Old Growth Designations by watershed and management area.

Watershed	Management Area	Compartment	Stand	Acres
Coosa	3.A National Scenic Area	395	005	17.3
			006	16.3
			007	14.0
			010	26.2
			011	14.0
			014	16.7
			016	37.4
			018	19.0
			019	33.4

			021	34.8
			022	29.9
			023	48.8
			025	12.9
			029	18.2
		Coosa – Total		339
Young Cane	7.E.1 Dispersed Recreation	404	004	37.8
			005	17.3
			006	25.3
			015	56.6
			023	20.8
			024	19.5
			025	16.1
			026	65.6
		YC – Total		259
Cooper	3.A National Scenic Area	501	004	54.0
			009	38.3
			010	37.4
			014	44.8
			019	45.8
			020	35.1
			023	26.3
			025	36.5
			030	28.0
			032	29.9
			033	31.8
			038	18.7
			040	17.2
			042	17.4
			046	30.9
			047	29.4
			049	18.3
			050	46.3
			056	15.7
			057	33.6
			058	25.6
	1.A Designated Wilderness	392	001	8.4
			032	54.0
			033	217.7
			034	42.9
			035	159.5
			036	57.8
	7.E.2 Dispersed Rec with Veg	504	009	34
		Cooper-Total		1,235
		Project -Total		1,834

Field analysis of the stands proposed for vegetation management treatment determined that although some of the stands were found to contain individually older trees, the number of trees per acre for the upper age class did not meet the number required to satisfy the old growth criteria. In addition, most stands did not meet other old-growth criteria, primarily the evidence of human disturbance. Only

stands proposed for vegetation management were examined. Other stands within the project area may meet old growth criteria. Further field evaluation would be required to determine which of these areas meet all requirements set forth in the Forest Plan and Region 8 old growth guidance. If they do meet these characteristics, a decision may then be made at that time to allocate additional areas to old growth management.

3.9.2 Effects on Old Growth

Measure: Effects of project on Old Growth Forest conditions.

***Bound of Analysis*: Spatial:** approximately 60,371 acres of total acreage, 34,018 acres of National Forest land and 26,353 acres of Privately Owned land, **Temporal:** Approximately 10 years following implementation.

Alternative 1 – No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct effects to potential old-growth habitats are expected outside of the proposed prescribed dormant season burn units. Over time, some of the older stands would reach minimum old-growth age and begin to develop other old-growth characteristics.

The stands approaching minimum age criteria have the potential to be prescribed burned in existing prescribed dormant season burn units. The units would be prescribed burned during the dormant on a landscape-scale. This treatment would not negatively affect the area's ability to meet old- growth criteria. Instead, it has the potential to improve the area's chances of surviving a catastrophic wildfire as well as increasing the likelihood that oaks and other fire dependent species would be retained on-site.

Cumulative Effects - Natural disturbances such as wildfire, ice and wind damage, and insect damage could potentially affect possible or future old growth forest during the next 10 years, but this amount or its effects cannot be predicted. Natural events could improve old-growth characteristics such as canopy patchiness and downed woody material, or completely destroy the oldest age class of trees on an entire slope.

Alternative 2 (Proposed Action) and Alternative 3
Direct and Indirect Effects – Proposed activities in Alternative 2 or 3 would not greatly affect the availability of possible old-growth forest, the ability of the stands to meet old-growth criteria, or negatively affect the development of future old growth forest since proposed activities such as prescribed burning would only perpetuate and sustain these communities and mechanical treatments are limited to approximately 6% of the project area.

In alternative 2, of the 2,315 acres in the project area analyzed for commercial treatments, 34 acres were found to be either of minimum age to qualify as old growth, or be within 10 years of qualifying. This stand, Compartment 504 Stand 09, is proposed for woodland restoration. It meets all criteria for old growth consideration except for the evidence of human disturbance. This treatment would move the stand toward meeting woodland old growth criteria, however, it would also increase the evidence of human disturbance, thus negatively impacting the short term potential to fully meet old growth criteria. In alternative 3, of the 1,679 acres in the project area analyzed for mechanical treatments, no stands

were found to be either of minimum age to qualify as old growth, or be within 10 years of qualifying. Although the above mentioned stand, Comp 504 Stand 09, is still proposed for treatment, it is proposed for non-commercial thinning under this alternative. This treatment should not have any negative impact on the stands old growth characteristics, in fact, it should move the stand more rapidly towards old growth woodland characteristics, any evidence of human disturbance from the non-commercial thinning would be consumed in the prescribed burning of the stand.

An additional activity planned for the Cooper Creek Watershed project analysis area that may affect the availability or development of old growth forests is dormant-season or early growing season planned ignitions. Some of the areas meeting minimum age criteria have the potential to be located within existing planned ignitions units, over the life of this project. The units would be prescribed burned during the dormant season or growing season on a landscape-scale. This treatment would not negatively affect the area's ability to meet old-growth criteria. Instead, it has the potential to improve the areas chances of surviving a catastrophic wildfire as well as increasing the likelihood that shortleaf pine and oak would be retained on-site.

The use of prescribed fire in these old growth types is necessary to perpetuate dominant fire-dependent tree species. Prescribed burning is compatible with old growth conservation, because it generally affects smaller diameter trees and incidents of mortality to larger diameter trees is generally localized. In such cases, mortality would contribute to old growth characteristics by forming gaps, snags and downed woody debris, and patchiness in understory and overstory vegetation. Consumption of existing down woody debris could result, but would be replaced by the formation of additional snags resulting from potential incidents of localized mortality of larger overstory trees.

Natural disturbances such as wildfire, ice and wind damage, and insect damage could potentially affect future old growth forest during the next 10 years, but this amount or its effects cannot be predicted. Natural events could improve old-growth characteristics, such as canopy patchiness and downed woody material, or completely destroy the oldest age class of trees on an entire slope. These alternatives in combination with other planned treatments would not negatively affect old growth forest or associated species.

Cumulative Effects - Past activities in the Cooper Creek watershed affecting old growth habitat include dormant season prescribed burning over the last several years. A few small block old growth and/or non-conserved potential old growth stands may have been included in this burning. Prescribed burning reduced understory vegetation, comprised of fire sensitive species less than five inches in diameter. No appreciable effect to larger trees resulted. Present or reasonably foreseeable activities which would affect old growth habitat include prescribed burning in the project area that would be authorized under the Cooper Creek Decision Notice. These activities would be planned following the winter or spring of 2016 and for the next 5-10 years.

Prescribed burning in these old growth types would restore and maintain native plant communities by improving conditions for oak regeneration. Old growth characteristics would not be negatively affected in the other stands and small gaps, patchiness in understory vegetation, and creation of snags could result. The cumulative effect of this alternative in combination with past, present, and reasonably foreseeable actions would not appreciably affect old growth habitat in the Cooper Creek watershed. Proposed activities would perpetuate native plant communities in non-conserved potential old growth

stands (oak) while retaining or creating old growth attributes (large trees, snags, patchiness, gaps, and downed woody debris).

3.10 Snags, Dens, and Downed Wood

3.10.1 Affected Environment

Snags, dens, and downed wood are important habitat elements for a variety of wildlife species. Large snags are used as nesting and feeding sites and perches by birds, and roosting and maternity habitat for bats. Den trees are used for nesting, roosting and hibernating by a variety of species. Downed woody debris provides cover and feeding sites for amphibians, reptiles, small mammals, and invertebrates, as well as unique uses such as drumming logs for ruffed grouse. These elements are typically most abundant in older forests. According to FSVeg data, approximately 60% of project area contains trees that are older than 80 years. Snags, den trees, and downed wood are abundant throughout the project area, some as a result of past southern pine beetle activity, periodic ice and windstorms, and fire. Snags and downed wood are expected to increase in drains where hemlocks are predicted to succumb to the non-native hemlock woolly adelgid (HWA) within a few years. As the entire watershed continues to age, snags, den trees and down wood would continue to become increasingly abundant.

3.10.2 Effects on Snags, Dens, and Downed Wood

Measure: Effects on habitat conditions and populations of associated species from project activities. ***Bounds of Analysis*****: – Spatial:** the Cooper Creek Watershed Analysis Area includes is approximately 34,000 acres National Forest and adjacent private lands. **Temporal:** Approximately 10 years following implementation.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no effects to snags, dens, and downed wood would be expected. Over time, the amount of mid-late successional habitat would increase as the forest in the area matures. This should result in improved habitat conditions for a variety of species that utilize snags, dens, and downed wood.

Cumulative Effects - Recruitment of snags, dens, and downed wood is most dependent on providing abundant late successional forests. The availability of these habitats is expected to increase through time with the implementation of the Forest Plan (USDA Forest Service 2004a). The ongoing prescribed burning within the watershed is the only activity which would have an effect on snags, down wood and/or den trees which occur within the Cooper Creek watershed. These burn units comprise about 40% of the Cooper Creek watershed. While, most of these previous burns were of low to moderate intensity, pockets of higher intensity are present in these burn units. This coupled with a limited number of wild fires in the area have resulted in the creation of ample snags. Since over a decade has passed since some of these burns, many of the snags have fallen and are now serving as down woody debris. Although some den trees were likely destroyed as a result of these fires, given the vast acreage of mature forest within the project area, this effect would be negligible. The effects of these ongoing burns coupled with other past, present and reasonably foreseeable future actions are likely to increase the amount of snags and down wood within the watershed. This would constitute a beneficial effect on wildlife species which depend on snags and down wood.

Alternative 2: Proposed Action

Direct and Indirect Effects- The activities included within the Proposed Action Alternative which could have an effect on snags, dens and down wood within the Cooper Creek watershed include: 1) Oak/Oak-Pine Thinning, 2) Pine/Pine-Oak Thinning, 3) Canopy Gap Thinning, 4) Early Successional Habitat Treatments, 5) Woodland Restoration Treatments,6) Release Treatments, 7) Midstory Treatments, and 8) Prescribed Burning. However, Forest-wide standards would be followed that ensure the retention and recruitment of these habitat elements on the landscape. Commercial timber harvest operations would be prescribed in a manner to provide adequate snags, down wood and den trees. In the thinning and other intermediate timber operations, existing snags and den trees would be retained. Some additional snags, den trees, and downed woody debris may be created as a result of timber harvest operations during these treatments. Non-commercial treatments via "cut and leave" mechanical operations would also increase the amount of down wood within the project area. The prescribed fire treatments proposed in this alternative may impact existing snags and downed wood. However, prescribed fire also is likely to increase the amount of standing snags within the project area by causing direct mortality of living trees. In addition, prescribed burning would also increase the amount of down wood by burning down some standing snags that are present prior to the burn. Den trees could be decreased through prescribed burning, if existing den trees catch fire during the burning operation. Overall, the quantity of available snags and downed is expected to increase over time as a result of the periodic prescribed burns.

Forest Plan standards incorporated into this project in order to provide existing and future snags, den trees, and downed woody debris include: 1) known black bear den sites would be protected from disturbance within 100 feet; 2) potential black bear den trees would be retained (trees greater than 20" dbh, hollow with broken tops); 3) existing snags and den trees would be retained during the timber harvest operations, 4) if at least two snags per acre are not present or cannot be retained, at least two snags would be created from large diameter trees, and 5) a minimum of five of the largest diameter class trees per acre would be retained to provide future snags (this can include existing den trees) (Forest Service 2004b p. 2-8, 9, 27).

The cut-stump and foliar pesticide treatments included in this Alternative would have little effect on the amount or distribution of snags, den trees, or downed wood. Pesticide treatments are primarily designed to prohibit resprouting of cut vegetation, or to top-kill competing small diameter vegetation. However, the herbicide stem injections such as is prescribed in the midstory and release treatments will increase the availability of standing snags. Over time, as these snags fall, they would function as down woody debris within the project area.

Although some reduction in the existing of snags, downed wood and den trees may occur as a result of the implementation of this alternative (mainly through prescribed burning), the overall effect would be null since additional snags and down wood would be created through project implementation. Implementation of Forest Plan standards would also ensure these habitat elements are protected during commercial timber harvest. Due to the abundance of late-successional, mature, forest habitat within the project-area, over time, snags, down wood and den trees would become increasingly more abundant as the forest ages. Given these factors, this alternative would have no negative direct or indirect effect on the abundance of snags, den trees or down wood.

Cumulative Effects - Recruitment of snags, dens, and downed wood is most dependent on providing abundant late successional forests. The availability of these habitats is expected to increase through time with the implementation of the Forest Plan (USDA Forest Service 2004a). The Forest plan has several standards that ensure the retention and recruitment of snags and den trees. The actions proposed in this alternative coupled with ongoing prescribed burning and other past, present and reasonably foreseeable future actions are likely to increase the amount of snags and down wood within the watershed. This would constitute a beneficial effect on wildlife species which depend on snags and down wood.

Alternative 3

Direct and Indirect Effects - Due to the similarities between alternatives, the direct and indirect effects of this alternative would be similar as disclosed under the Proposed Action. The increase in acres of non-commercial (cut and leave) canopy gap and woodland restoration treatments would likely create more down woody debris than in Alternative 2. However, this will at least be partially off-set by a substantial reduction in the acres of midstory treatments. All other small scale differences between this alternative and the proposed action alternative would not constitute a measureable difference in direct or indirect effect between alternatives.

Cumulative Effects - Recruitment of snags, dens, and downed wood is most dependent on providing abundant late successional forests. The availability of these habitats is expected to increase through time with the implementation of the Forest Plan (USDA Forest Service 2004a). The Forest plan has several standards that ensure the retention and recruitment of snags and den trees. The actions proposed in this alternative coupled with ongoing prescribed burning and other past, present and reasonably foreseeable future actions are likely to increase the amount of snags and down wood within the watershed. This would constitute a beneficial effect on wildlife species which depend on snags and down wood.

3.11 Aquatic Habitats (including TES Aquatics)

3.11.1 Affected Environment

Much of the following summary is derived from the Chattahoochee-Oconee National Forest's Land and Resource Management Plan Final Environmental Impact Statement (USFS 2004). The Chattahoochee National Forest (CNF) has 2,436 miles of perennial streams. About 1,770 miles (72 percent) are classified as cold water streams. The remaining 666 miles (28 percent) are classified as cool water streams.

Most of the cold water streams on the CNF have steep gradients (more than 4 percent) and are small, order 3, to medium sized streams, order 7 (Strahler 1957). Cold water aquatic habitat consists primarily of narrow, shallow pools with numerous cascades and waterfalls. Predominate fish cover is of boulders and rock ledges. Lower gradient stream segments in these headwaters provide more optimum fish and macro-invertebrate habitat of long riffles and deep, long pools with woody debris. Because of historic land uses in many areas streams are often lacking in woody debris which provides habitat and cover for aquatic organisms while buffering streams against high flows. Gregory et al. (2003) provides a summary of the importance of wood in streams and rivers.

In these cold water streams, the diversity of fish species and number of individuals is low compared to warm or even cool water streams. The dominant predatory fish in these streams is trout (Salmonidae).

Coldwater streams generally have water temperatures that seldom exceed 72^{o} F in the summer. Factors attributing to low biological diversity are water chemistry parameters, as well as the comparatively low number of species adapted to cold water with high flow regimes. Water quality in coldwater habitats is generally described as infertile with total alkalinity less than 20 ppm; total hardness less than 20 ppm; and neutral (pH 7.0) to slightly acid (pH 5.5). Forested riparian corridors are essential for maintaining cold water habitats. They provide shade and high water quality for all streams, and trout are particularly sensitive indicators of stream health. Trout streams require additional protection to maintain high water quality and low stream temperatures. The Georgia BMPs for trout streams include 100 foot minimum streamside management zones (SMZs) on both sides of designated streams and tributaries, with two options for retaining adequate canopy cover and shade (Georgia Forestry Commission 2009). Forest Service riparian corridor standards meet or exceed the Georgia BMPs for trout streams on all intermittent and perennial streams.

Salamanders are most abundant at higher elevations on the CNF. The most important limiting factor to the occurrence of salamanders is moisture content. Salamanders depend on their skin remaining moist at all times. In higher elevations, temperatures are cooler, resulting in lower evaporation rates. In addition, moisture content is high in headwater streams due to dense canopy cover and high rainfall. The highest diversity as well as number of salamanders is in areas of high elevations within the Blue Ridge ecoregion. This richness is due to the topography structure and habitat diversity of this ecoregion. Salamanders of the Chattahoochee and Oconee National Forests (Camp et al. 2004) provides a list of salamanders with the potential to occur on the Blue Ridge Section of the Chattahoochee-Oconee National Forests and it also provides a more detailed overview of their habitat requirements.

Below about 1,200 feet in elevation, streams are generally cool water. These streams are less suitable for trout but the diversity of fish increases due to increased nutrients, warmer water, slower stream flows and increased stream widths and depths creating more habitat niches. The habitat within these streams consists of longer, deeper pools with less gradient than those of cold water. Woody debris provides additional cover to boulders and rock ledges. Mussels are likely to occur in slow riffles, long pools and backwater areas. The dominant predatory fish is redeye bass. Cool water habitats generally have slightly higher alkalinity and hardness levels but the pH levels are comparable to the coldwater streams. These streams have water temperatures that exceed 72^{o} F in the summer for extended periods. Stream size (order) is similar to coldwater streams with only a small percentage being classified as large rivers, order 8 or 9 (Strahler 1957). Cold and cool water streams are stocked with trout. The Georgia Department of Natural Resources, annually stocks 144 miles of stream with brown and rainbow trout on at least 35 streams on the CNF.

Currently, some of the largest effects to aquatic habitat and species come from the road system. Roads negatively impact streams and wetlands in a number of ways. They increase, concentrate and accelerate the amount of runoff which can lead to warmer water temperatures and the runoff can cause flashy flows and streambank and in-stream erosion. Roads also intercept and divert subsurface flow, reduce groundwater recharge and can indirectly lead to the conversion of wetland vegetation types to upland types (Brooks et al. 1997). At road stream crossings movement of aquatic organism is often limited and pollution including sediment is often delivered to streams. Waters (1995) provides an extensive overview of the negative effects sediments can have on aquatic habitats and organisms. In general sediment fills in pools and covers spawning gravel which leads to a more homogeneous habitat; it also causes the stream to get wider and shallower leading to warmer water temperatures and less

desirable habitat. Roads also fragment the watershed limiting animal movement and reducing the amount of usable terrestrial habitat.

In the southern Appalachian Mountains which includes most of the CNF other threats to aquatic habitat and fauna besides sediment would be climate change and streams turning more acidic because of a lack of buffering capacity. McDonnell et al (2015) modeled various scenarios that estimated the amount of coldwater habitat available to trout considering both a lack of buffering capacity in streams and increases in water temperature from climate change. They used 50µeq/L of acid neutralizing capacity (ANC) as the lowest level of buffering capacity before stream acidity would begin affecting brook trout and 20^{o}C as the upper temperature threshold. A lack of buffering capacity usually affects higher elevation headwaters streams first whereas increases in water temperature would typically be recognized lower downstream first. In essence, coldwater species such as trout would be squeezed in between with water upstream too acidic and water downstream too warm. McDonnell et al (2015) estimated that if there were a 2^{o} C mean air temperature increase in July there would be over a 30% reduction in suitable coldwater habitat on the CNF. ANC sampling results from the past few years in the Cooper Creek Watershed Project Area show that all the streams sampled had an ANC value greater than the 50µeq/L threshold used by McDonnell et al (2015).

Throughout the entire CNF Hemlock Woolly Adelgid (HWA), an invasive insect introduced from Asia, is killing hemlock trees which often occur in riparian areas along streams. The highest tree mortality seems to be on the eastern part of the CNF, but tree mortality is noticeable in the Cooper Creek Watershed Project Area. As a hemlock tree dies from HWA the tops seem to break of first and then the rest of the tree seems to break apart. While additional wood in riparian areas and streams is beneficial the way the tree breaks apart into smaller pieces limits the benefits.

Within the Cooper Creek Watershed Project there are three 6th level watersheds, Cooper Creek, Coosa Creek and Youngcane Creek watersheds. The following paragraphs are a summary of current conditions of these watersheds.

Cooper Creek Watershed (6th Level HUC 060200030102)

GIS analysis shows this watershed being 25,290 acres in size with 93% being NFS Lands. There are 86 miles of stream, but less than 1% of the surface area of the watershed is water. There are 58 miles of road in the watershed with approximately 11 miles of the roads being within 100 ft. of a stream. There are also over 23 miles of trails in the watershed. Major streams in this watershed include, Cooper Creek, Burnett Creek, Jarrard Creek, Garrett Creek, Board Camp Creek, Logan Creek, Flat Creek, Bryant Creek and Pretty Branch, Mulky Creek, Long Branch, Dixon Creek, Clements Branch, Jones Creek and Doff Branch. Cooper Creek runs primarily in an east to west direction through the watershed and the other stream are tributaries to Cooper Creek. Previously all of these streams were designated as seasonal trout streams, but this year the Georgia Board of Natural Resources made a decision to have all trout streams remain open year-round. Cooper Creek is the only stream in the watershed that is stocked by the Georgia Department of Natural Resources.

In 2014 and 2015, habitat assessments were completed on Cooper Creek, Burnett Creek, Board Camp Creek and Burnett Creek. The following table summarizes some of the results of the survey.

Table 3.11.1 Summary statistics for habitat surveys of streams in the PA.

	Cooper Creek	Burnett Creek	Boardcamp Creek	Bryant Creek

Distance Sampled (km)	3.5	3.5	2.0	5.5
% Pool and Glide	11	13	13	25
% Riffle, Run and Cascade	89	87	87	75
Average Depth Pool and Glide (cm)	56	18	30	34
Average Depth Riffle, Run and Cascade (cm)	37	14	14	17
Average Width Pool and Glide (m)	13.3	2.2	1.6	3.7
Average Width Riffle, Run and Cascade (m)	10.1	3.0	2.4	4.3
% Fines Pool and Glide	46	79	35	40
% Fines Riffle, Run and Cascade	14	40	12	14
Large Woody Debris/km	117	155	136	196

Cooper Creek is considerably larger than other sampled streams. All of the streams have substantially more riffle and run habitat than pool and glide habitat. The percent of fines in pools and riffles is considerably higher in Burnett Creek than the other streams. It is unclear whether there is legacy sediment in this stream from previous land use or it is a more recent occurrence. A review of stand information shows two white pine stands totaling 58 acres adjacent to Burnette Creek were treated in 1994 and there have been two recent burns in the watershed. It is also possible that sediment from Duncan Ridge Road is ending up in Burnette Creek. While it is unclear what the source of the fines is, it does not appear that they are being flushed out of the stream quickly.

While all four streams have LWD in them over half of the total number pieces counted in the three streams fell into the smallest size category (1-5 m length, 10-55 cm diameter). This lack of larger pieces of LWD could be contributing to the low percentage of pool and glide habitat in these streams. Information on riparian hemlock trees was also collected during the surveys. Hemlocks were present in all survey reaches and abundant in some, however many of the hemlocks were in what was classified as the late mortality stage. While hemlock trees are dying they do not seem to be contributing a large amount to LWD in the streams. This is probably because most of the trees seem to lose their tops first and then break apart. It is believed that the other streams in this watershed have similar habitat characteristics to Burnett, Board Camp and Bryant creeks.

Cooper Creek is listed as 303(d) impaired (more information pertaining to this listing can be found in the Water Section). This listing is based on stream fish sampling at two sites. Data from these two sites was extrapolated to list approximately 10 miles of stream. The first site is just downstream of Lake Winfield Scott, where Cooper Creek and it tributary streams are all impounded. The second site was adjacent to an area known as Shope Fields, the sampled site includes a ford along with a dispersed camping sites where RVs are often parked adjacent to the stream and it is apparent that the stream in this area has been altered by recreational use. The manual Standard Operating Procedures for Conducting Biomonitoring on Fish Communities in Wadeable Streams in Georgia, (GA DNR 2005) indicates sampling sites should be representative of the stream being sampled, A field review of these sites seems to indicate that they are not representative of the rest of the stream. Cooper Creek is a high quality stream that contains a diverse stream fish population that includes species such as rainbow trout, brown trout, river chub, creek chub, Tennessee shiner, redline darter, greenside darter, northern hogsucker, longnose dace, stoneroller and sculpin. It also provides habitat for other aquatic species such as hellbenders. In recent years places such as the Georgia Aquarium have contacted the

Chattahoochee-Oconee National Forest about collecting fish from Cooper's Creek because of the diverse fish population. Tributary streams to Cooper's Creek are also high quality as most support self-sustaining trout populations with some supporting native brook trout. With that being said Cooper's Creek is experiencing various negative resource impacts at this time. Approximately 11 miles of roads in the watershed are within 100 feet of a road and they are negatively impacting aquatic resources in some areas. Water runs directly off the road into the stream which causes at least two problems from a water quality standpoint. First, sediments and other pollutants from the road are washed directly into the stream. Second, more water drains more quickly into the stream because the road is compacted and there is very little infiltration into the road. The result of this is increased water temperatures and potentially stream bank and in-stream erosion. The Water and Soils analysis of this document further describe the physical portions of the watershed including roads and areas with erosion problems. There are also impacts to riparian areas along streams from the amount of recreational use in this watershed. It is not uncommon to see dispersed camp sites right next to streams and there are also user created trails along the streams and in many cases there is very little vegetative growth in these areas.

Brook trout in the Southern Appalachians are typically found in small headwater streams above a barrier and often they are the only fish species in that portion of the stream. Burnett Creek, Pretty Branch, Boardcamp Creek, Logan Creek and Bryant Creek all contain brook trout. In recent years the U.S. Forest Service has worked with the GA DNR and the Georgia Council of Trout Unlimited to improve stream habitat in these streams by placing LWD. The Forest Service also in recent years replaced a perched culvert on Bryant Creek with a bottomless arch culvert that allows aquatic species to move more easily up and downstream and this ultimately provides more available habitat. There are plans in the future to install similar structures on Pretty Branch and Dixon Branch.

Coosa Creek Watershed (6th Level HUC 060200020505)

GIS analysis shows this watershed being 14,364 acres in size with 44% being NFS Lands. There are 47 miles of stream, but less than 0.5% of the surface area of the watershed is water. There are 12 miles of Forest Service Roads in the watershed with approximately 5 miles of the roads being within 100 ft. of a stream. There are also over 5 miles of trails in the watershed. Major streams in this watershed include, East Fork Coosa Creek, Gillespie Branch, Miller Cove Branch, West Fork Coosa Creek, Mulky Gap Branch, and Hicks Gap Branch. For the most part the headwaters of these streams occur on National Forest Land and flow north onto private lands. Because more of the streams occur on private lands less recent information is available on the aquatic habitats and fauna of these streams. All of the streams in this watershed have been designated as year round trout streams, but only Coosa Creek is stocked by the Georgia Department of Natural Resources. Keefer (2003) conducted sampling in the East Fork of Coosa Creek near its confluence with Roaring Fork and captured wild rainbow trout. Species captured in Mulky Gap Branch included rosyside dace, creek chub and sculpin along with various salamander species. Coosa Creek was sampled in 1993 (Freeman) and species captured included stonerollers, mirror shiners, longnose dace, norther hogsuckers, mottled sculpin, redbreast sunfish and redline darter. No trout were captured during sampling in either of these streams.

Youngcane Creek Watershed (6th Level HUC 060200020506)

GIS analysis shows this watershed being 20,717 acres in size with 20% being NFS Lands. There are 78 miles of stream, but less than 2% of the surface area of the watershed is water. There are 6 miles of Forest Service Roads in the watershed and almost 12 additional miles of other government roads in the watershed. Approximately 8 miles of the roads are within 100 ft. of a stream. There are also over 6 miles of trails in the watershed. Major streams in this watershed include, Reynolds Branch, Payne

Creek, Mason Branch and Little Youngcane Creek. Like the Coosa Creek watershed , for the most part the headwaters streams in this watershed occur on National Forest Land and flow north onto private lands. Because more of the streams occur on private lands less information is available on the aquatic habitats and fauna of these streams. All of the streams in this watershed have been designated as year round trout streams, but none of the streams in this watershed are stocked by the Georgia Department of Natural Resources.

TES Species

A review of the GA DNR's Natural Heritage Database, GA DNR's Conservation Status Assessment Maps (http://www.georgiawildlife.com/conservation_status_assessment_maps), Amphibians and Reptiles of Georgia (Jensen et al. 2008) and sampling records show that there are not any Federally Endangered or Threatened aquatic species known to occur in these three watersheds. There are two sensitive fish the wounded darter and the olive darter that occur in the Toccoa River Watershed of which Cooper Creek is a part of, but they are known to occur downstream of the Project Area. There are two sensitive aquatic insects that have the potential to occur in these watersheds. They are the mountain river cruiser and the Appalachian snaketail (FEIS 2004, Appendix F). More information can be found on these two species in Appendix I of the FEIS (2004). There also are several locally rare aquatic species that occur downstream of the project area in the Toccoa River including the tangerine darter, blotched chub, banded darter, and bigeye chub.

In addition to the TES species these three watersheds also provide habitat for a number of salamander species, most notably the Eastern hellbender. Camp et al. (2004) provides an overview of salamander species that occur on the Chattahoochee-Oconee National Forest.

3.11.2 Effects on Aquatic Habitats (including TES Aquatics)

Measure: Effects on habitat conditions and populations of associated aquatic species from project activities.

***Bounds of Analysis*: Spatial:** The Cooper Creek Watershed Project occurs within the Cooper Creek 6th level HUC (060200030102), Coosa Creek 6th level HUC (060200020505) and the Youngcane Creek 6th level HUC (060200020506). Direct, Indirect and Cumulative Effects Analysis (CEA) will be done at the 6th level HUC scale because at this level cumulative effects are still distinguishable whereas at a larger scale cumulative effects begin to be diminished. **Temporal:** The project implementation schedule is five years and the CEA will extend ten years beyond this.

Alternative 1: No Action

Direct and Indirect Effects

Under this alternative none of the proposed silvicultural treatments, transportation management, and road construction would occur. However, the nine prescribed burns described in Chapter 2 which total 11.842 acres would take place. These would be dormant season burns only and would typically occur on a 3-5 year burn cycle. Three hundred ninety-seven acres of burning would occur in the Youngcane Creek watershed, 930 acres in the Coosa Creek watershed and 10,515 acres in the Cooper Creek watershed. Burn units would be designed to utilize roads, trails and streams as fire breaks to minimize the amount of firelines that needs constructed.

Direct and indirect effects of burning would include sediment input to streams and other aquatic habitats primarily from fire lines, but there could be occurrences where heavy rain follows a burn before an area revegetates and this could result in increased amounts of sediment being introduced into

aquatic systems. The effect of sediments in streams was discussed in the current conditions. Overall, if BMPs are followed and burn lines are seeded quickly following a burn it is unlikely that under this alternative enough sediment would be introduced into aquatic habitats to affect aquatic fauna. There is also expected to be ash deposited into aquatic habitats during burns, but this is expected to be minimal and should not affect aquatic fauna.

Prescribed fire typically burns out or forms a mosaic as it moves into the moister riparian areas along streams and water so there is not expected to be any direct effect to aquatic habitat shading or riparian buffers.

Renken (2005) reviewed information on the effect of fire on amphibians and reptiles in Eastern U.S. oak forests and results suggest that fire results in little direct mortality to amphibians and reptiles and had no overall effect on amphibian abundance, diversity, and number of species in comparisons of burned and unburned plots, although salamander numbers tended to be greater in unburned plots. The season of the burns also did not seem to make a difference in response either. Ford et al. (2010) monitored salamander response to two prescribed fires in the central Appalachians and found no difference in salamander assemblage prior to burning or afterwards.

Cumulative Effects

Under this alternative only prescribed burning would be authorized, but this analysis also considers past, present and reasonable foreseeable activities described in Table 3.2.1. Kolka (2012) provides an overview of the effects of fuel management in the Eastern U.S. Overall, because of the small amount of burning that would occur in the Coosa Creek and Youngcane Creek watersheds there is unlikely to be any cumulative effects to aquatic fauna or habitats in these watersheds.

In the Cooper Creek watershed where over 42% of the watershed will be prescribe burned on a rotational basis there is likely to be some sediment introduced into aquatic systems from both overland flow and prescribed fire lines. Sediment introduced into the smaller streams that are tributary to Cooper Creek would be more likely to have a negative effect on aquatic habitat and fauna than it would in the larger Cooper Creek. Over time the sediment will move through the system, but as it does an area will be burned again and more sediment could be introduced.

There is also the potential for increased water yield under this alternative (see Water Section) and this could benefit aquatic species especially in years of drought as more water would be in streams thereby providing more habitat.

Fisheries work in these watersheds will continue to focus on restoring aquatic habitat for native brook trout and other aquatic species. Habitat improvements such as adding woody debris to streams and reconnecting fragmented habitats through road stream crossing upgrades will improve aquatic habitat. Over time as the forest matures and trees including hemlocks die and fall this will provide more structure and habitat both in riparian areas and in streams. This would provide more habitat diversity and cover for amphibians such as salamanders, fish and other aquatic species. As the hemlocks die off there could be some minimal temporary water temperature increases over time the hemlocks will be replaced in the canopy and the stream temperatures will be restored. Overall, while it is expected that some sediment is likely to be introduced into aquatic habitats under this alternative it is not expected to have a negative cumulative effects to aquatic habitat and associated species under this alternative.

Alternative 2: Proposed Action

Direct and Indirect Effects

Prescribed Burning

The amount and location of prescribed burns are the same as Alternative 1 although a portion of these burns may occur during the growing season under this alternative. The direct and indirect effects are the same as described under Alternative 1.

Transportation Management

Under this alternative there would be 2.8 miles of road reconstruction with 1.8 miles occurring in Cooper's Creek watershed and 1 mile in the Coosa Creek watershed. There would be 5 miles of temporary road construction with 3.5 miles occurring in the Cooper Creek watershed and 1.5 miles occurring in the Coosa Creek watershed. There would be 21.6 miles of seasonal road closures with 19.6 miles occurring in the Cooper's Creek watershed and 2 miles in the Coosa Creek watershed. There would also be 6.7 miles of year round road closures all occurring in the Cooper's Creek watershed. No transportation management activities would occur in the Youngcane Creek watershed.

Ground disturbance will occur during road reconstruction and during construction of temporary roads. The effects to aquatic habitats and species will be minimized by following BMPs and mitigation measures. Also construction of temporary roads should not occur in riparian areas except to cross a stream. Even with BMPs it is expected that some sediment will be delivered to aquatic systems during construction and use. Once temporary roads are closed and revegetated this source of sediment should be minimized, although by not obliterating temporary roads the road prism remains in place and can negatively impact aquatic habitat.

While the Cooper's Creek and Coosa Creek Watershed are 25,290 and 14,364 acres respectively silvicultural treatments are concentrated in the Bryant Creek, Pretty Branch, Mulky Gap Branch, West Fork Coosa Creek, East Fork Coosa Creek and Gillespie Branch drainages so it is expected that temporary road construction would also occur in these drainages and there could be some sediment delivery into these streams from temporary road construction.

Year round and seasonal road closures should benefit aquatic systems by eliminating some of the runoff from roads and ultimately sediment delivery to streams, however the road prism will still be in place so reductions are not expected to be significant.

Herbicide Treatment

A total of 3,251 acres of herbicide treatment with 1,934 acres of treatment occurring in the Cooper's Creek watershed and 1,327 acres in the Coosa Creek watershed. No treatments would occur in the Youngcane Creek watershed. By adhering to BMPs and mitigation measures it is unlikely that herbicides would be introduced directly into surface waters and directly affect aquatic fauna. Results of a risk assessment on these herbicides on aquatic species can be found in Appendix F. Indirectly as discussed in the water section there is the potential for an increase in water yield that could be beneficial to aquatic fauna by providing more water in the stream channel.

Silvicultural Treatments

Under this alternative there are 3,754 acres of silvicultural treatments proposed with 1,935 occurring in the Cooper Creek watershed and 1,819 acres occurring in the Coosa Creek watershed. In the Cooper Creek watershed 1,444 acres would be treated commercially and 491 acres would be treated non-commercially. In the Coosa Creek watershed 871 acres would be treated commercially and 949 acres would be treated non-commercially. No silvicultural activities would occur in the Youngcane Creek watershed.

During the commercial timber harvest operations there is expected to be some sediment delivered to aquatic habitats and as mentioned previously excessive sediment in aquatic systems negatively effects aquatic habitat and species (Waters 1995). Besides the temporary road and road reconstruction that is discussed in the transportation subsection other potential sources of sediment are skid trails and log landings. However, within the 100 foot streamside management zone (SMZ) there will not be any harvest within 25 feet of any stream and within the next 75 feet the minimal basal area (BA) remaining after harvest will be 50. Limiting the amount of ground disturbance within the SMZ will greatly reduce the potential for sediment to be directly introduced into aquatic habitats. The 25 foot buffer next to the streams will allow streams to remain shaded and maintain help maintain coldwater temperatures in the streams.

No ground disturbance would occur during non-commercial treatments and they are not expected to have a negative direct effect to aquatic resources although they may also result in an increase in water yield which could benefit aquatic habitat and fauna.

While Cooper Creek and Coosa Creek watersheds are 25,290 acres and 14,364 acres respectively silvicultural treatments are concentrated in certain drainages. In the Cooper Creek watershed the Bryant Creek drainage is 1,306 acres and treatments are proposed for 1125 acres or 86% of the drainage. Pretty Branch is 742 acres in size and 486 acres or 65% of the drainage is proposed for treatment. In the Coosa Creek watershed the headwater drainage area of Gillespie Branch is 207 acres and 168 acres or 81% of the drainage is proposed for treatment. Treatments are also concentrated in the Mulky Gap Branch, West Fork Coosa Creek and East Fork Coosa Creek drainages. The concern with so much activity in drainage at once is that if there is a storm event and areas have not revegetated sediment could be introduced into aquatic habitats. While a slight increase of sediment into these streams probably would not be detrimental to aquatic fauna a larger increase would be. Aquatic species that would be impacted by an increase in sediment would be brook trout, hellbenders, river cruiser and the Appalachian snaketail among others. The level of treatment in these drainages would be mitigated through the timing of timber sales and sequencing of entry into units. Potential areas of erosion will be seeded and revegetated once a sale unit is completed. Through these mitigation measures the potential for sediment delivery into aquatic habitats would be greatly reduced.

The effects of timber harvests on salamanders, though often researched, are not well understood (MacNeil and Williams, 2014). In their study in Indiana, MacNeil and Williams (2014) saw declines in encounters with salamanders in group selection and in clearcuts, but no evidence of decline in shelterwood cuts or sites adjacent to harvest. They also correlated temperature, soil moisture and canopy cover to salamander counts. They concluded that treatments that remove canopy cover negatively affect salamander abundance at a local scale immediately following harvest. McDonald (2001) in a study conducted on the Cherokee National Forest found that salamander abundance was reduced in a stream that had the area around it logged to a residual basal are of 20-30. Overall,

silvicultural activities that reduce canopy cover which under this alternative include canopy gap creation, woodland creation and regeneration harvest would reduce habitat available to salamanders. Woodland creation should occur on drier sites that are unlikely to contain salamanders and through the use of BMPs in particular management within the SMZ the direct affect to salamanders should be reduced.

As mentioned in the water section there is the potential for a greater water yield from silvicultural treatments and this could benefit aquatic species especially in years of drought as more water would be in streams thereby providing more available habitat.

Alternative 3

Direct and Indirect Effects

Prescribed Burning
The amount and location of prescribed burns under this alternative are the same as Alternative 1 and 2. The direct and indirect effects are the same as described for Alternatives 1 & 2.

Transportation Management
The amount of transportation management would be the similar as what is described under Alternative 2. There will be an additional 2.4 miles of year-round closure and 2.7 miles of system road decommissioning of in Alternative 3. As a result, there should be a further reduction in sediment delivery to streams in Alternative 3 which will benefit aquatic systems. There will be one acre of parking lot expansion under this alternative. While the parking lots will be another source of runoff, they should alleviate some of the problems in this watershed where parking often occurs along the sides of roads and in riparian areas.

Herbicide Treatment
A total of 1,327 acres of herbicide treatment with 1,019 acres of treatment occurring in the Cooper's Creek watershed and 438 acres in the Coosa Creek watershed. This is a reduction of 1,924 acres compared to Alternative 2. No treatments would occur in the Youngcane Creek watershed. By adhering to BMPs and mitigation measures it is unlikely that herbicides would be introduced directly into surface waters and directly affect aquatic fauna. Results of a risk assessment on these herbicides on aquatic species can be found in Appendix F. Indirectly as discussed in the water section there is the potential for an increase in water yield that could be beneficial to aquatic fauna by providing more water in the stream channel. Overall, because fewer acres are being treated under this alternative the potential effects to aquatic fauna and habitat should be less than Alternative 2.

Silvicultural Treatments
Under this alternative there are 2,571 acres of silvicultural treatments proposed with 1,803 occurring in the Cooper Creek watershed and 768 acres occurring in the Coosa Creek watershed. In the Cooper Creek watershed 891 acres would be treated commercially and 912 acres would be treated non-commercially. In the Coosa Creek watershed 340 acres would be treated commercially and 421 acres would be treated non-commercially. No silvicultural activities would occur in the Youngcane Creek watershed. These treatments are reduced from what is proposed under Alternative 2. Primarily the reduction is a result of stands on the north side of Duncan Ridge in the Coosa Creek watershed being dropped. There would be a reduction of impacts in the Mulky Gap Branch, West Fork Coosa Creek

and East Fork Coosa Creek drainages along with other streams where treatments were reduced under this alternative.

Treatments under this alternative are concentrated in the Bryant Creek, Pretty Branch and Gillespie Branch drainages. The Bryant Creek drainage is 1,306 acres and treatments are proposed for 1,086 acres or 83% of the drainage. Pretty Branch is 742 acres in size and 424 acres or 57% of the drainage are proposed for treatment. In the Coosa Creek watershed the headwater drainage area of Gillespie Branch is 207 acres and 100 acres or 48% of the drainage are proposed for treatment. There are some changes in stand prescriptions under this alternative such as, treatments in the headwaters of Gillespie Branch were changed from canopy gap and commercial thinning in Alternative 2 to regeneration harvests and canopy gap thinning under this alternative. As mentioned in the effects of Alternative 2 activities that reduce canopy cover would result in a loss of potential salamander habitat.
Overall, while treatments the direct and indirect effects under this would be similar to what is discussed under Alternative 2, but since there are fewer acres being treated there would be less direct impacts on aquatic fauna and habitat.

Cumulative Effects
In chapter one of Cumulative Watershed Effects of Fuel Management in the Eastern United States there is a statement "widespread land management activities have the potential to cause significant real impacts on aquatic systems in aggregate, even when the impacts of each individual, local project may be small or hard to measure" (Kolka 2012). While the Cooper's Creek Watershed Project should not be considered a widespread project there is the potential to affect aquatic habitat and systems because activities are concentrated in a few drainages.

For most of the activities proposed under Alternatives 2 and 3 the biggest concern from an aquatic habitat standpoint is the amount of sediment delivered to streams which would negatively impact aquatic habitat and fauna. As mentioned in the Affected Environment, Burnette Creek has a higher percentage of fines than other streams that were surveyed in the project area. Whether these fines are a result historic land use or were introduced more recently they do not seem to be flushed out of the stream. This suggests that if sediment is introduced into other streams in the project area it also has the potential to persist and this would negatively affect aquatic habitat and fauna.

This cumulative effects analysis considers all the prescribed burn, transportation, herbicide and silvicultural treatments proposed along with the past, present and reasonable foreseeable activities described in Table 3.2.1. As mentioned in the direct effects analysis of both Alternative 2 and 3 silvicultural treatments are concentrated in a few drainages. More acres of treatment are proposed under Alternative 2 and it is expected sediment as a result of silvicultural treatments, road reconstruction and temporary road construction sediment would enter Mulky Gap Branch, West Fork Coosa Creek, East Fork Coosa Creek, Bryant Creek, Pretty Branch and Gillespie Branch. The potential for sediment delivery to streams will be greatly reduced through the use of BMPs and mitigation measures discussed previously. Any sediment that is introduced into aquatic habitats would likely persist for a number of years, but it is not expected to be enough to negatively impact aquatic resources. Over time areas such as skid trails, log landings and temporary roads would revegetate and the potential for sediment reaching streams would be further reduced. If temporary roads are not removed the remaining road prism could continue to negatively affect aquatic habitat as described by Waters (1995). Under Alternative 3 activities cumulative effects to Bryant Creek, Pretty Branch and Gillespie Branch would be similar to those described above because treatments are similar. However, treatments are

reduced in the Mulky Gap Branch, West Fork Coosa Creek and East Fork Coosa Creek so cumulative effects from sediment delivery would also be reduced in these areas. Under both Alternatives any sediment that reaches Cooper's Creek or Coosa Creek would have a negligible effect because both of these streams are larger than their tributary streams.

The combined effect of silvicultural treatments, herbicide treatments and prescribed burning has the potential to increase water yield in the drainages were treatments are concentrated (see waters section) for a number of years and this could benefit aquatic fauna by providing more water in the stream channel. Over time as areas revegetate water yield would likely decrease. Under both Alternatives it is unlikely that increases in water yield would benefit Cooper's Creek or Coosa Creek because they are larger streams and the amount of increase in them would probably be negligible.

Areas proposed for woodland creation are typically drier sites that salamanders would not use, but if there are pockets in these units that are wetter and utilized by salamanders these habitats would most likely see reduced use by salamanders because of a more open canopy. Woodland stands would be maintained through the use of prescribed fire so these habitats would be lost in the foreseeable future. In stands where canopy gaps or regeneration harvest are proposed over time these areas will revegetate and have the canopy closure needed to provide habitat for salamanders.

Transportation management activities such as permanent and seasonal road closures should result in a decrease in sediment delivery to streams in the project area that will benefit aquatic systems over time although the expanded parking areas will increase runoff.

Fisheries work in these watersheds will continue to focus on restoring aquatic habitat for native brook trout and other aquatic species. Habitat improvements such as adding woody debris to streams and reconnecting fragmented habitats through road stream crossing upgrades will improve aquatic habitat. Over time as the forest matures and trees including hemlocks die and fall this will provide more structure and habitat both in riparian areas and in streams. This would provide more habitat diversity and cover for amphibians such as salamanders, fish and other aquatic species. As the hemlocks die off there could be some minimal temporary water temperature increases over time the hemlocks will be replaced in the canopy and the stream temperatures will be restored.

Overall, there is the potential for negative cumulative effects to aquatic habitat and associated species under both Alternatives 2 and 3, especially in drainages where treatments are concentrated, but through the use of BMPs and mitigation measures the potential for negative cumulative effects to aquatic fauna and habitat would be minimized.

3.12 Forest Interior Habitats

3.12.1 Affected Environment

Forest interior birds are associated with large contiguous blocks of mature, mostly deciduous forests. They avoid forest edges during nesting and can be sensitive to forest fragmentation. Most are Neotropical migrants that primarily nest and raise young in the temperate Americas. This group includes birds like the wood thrush *(Hylocichla mustelina),* ovenbird *(Seiurus aurocapilla),* Kentucky warbler *(Oporornis formosus),* cerulean warbler *(Dendroica cerulean),* worm-eating warbler *(Helmitheros vermivorum),* and yellow-throated vireo *(Dendroica dominica).* Landscapes with at least

70-80% forest cover provide quality habitat for forest interior species, because the relative amounts of forest edge is reduced. Levels of nest parasitism and predation have been negatively correlated to the amount of forest cover in the landscape (Robinson et al. 1995).

The Cooper Creek watershed is ideal habitat for forest interior birds, with over 90% of the watershed being forested, and lying within the central core of the Forest in a large contiguous forested habitat of over 300,000 acres. Forested habitat within this large contiguous block is primarily comprised of closed canopy forest. This type of habitat is ideal for forest interior birds. Some small openings such as road corridors, wildlife openings, and patches of ESH are present within and adjacent to the watershed, but these small openings do not fragment forest interiors when they are within a mostly forested landscape. The surrounding private lands are a mixture of forest land, pastures, and residential development.

Eight long-term breeding bird monitoring plots fall either within or adjacent to Cooper Creek watershed. These plots have been monitored annually by Forest Service Wildlife Biologists or Wildlife Technicians for over 20 years. Forest interior birds are commonly detected during these surveys including ovenbird, hooded warbler, black-throated green warbler, wood thrush, and worm-eating warbler. Other interior species less frequently detected include Kentucky warbler, yellow-billed cuckoo, and yellow-throated warblers.

3.12.2 Effects on Forest Interior Habitats

Measure: Effects on interior forest habitat conditions and populations of associated species from project activities.

***Bounds of Analysis*: – Spatial:** the Cooper Creek Watershed Analysis Area includes is approximately 34,000 acres National Forest and adjacent private lands. **Temporal:** Approximately 10 years following implementation.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct impacts to interior forest habitat are expected. The ongoing dormant season prescribed burns will have no effect on the availability of interior forest habitats. Through time, the amount of interior forest habitat would increase as the Forest matures. Due to the abundance of this habitat both within and adjacent to the Cooper Creek watershed, no direct or indirect effects to forest interior birds are expected from this alternative.

Cumulative Effects - Landscape-scale habitat patterns influence the effects of forest fragmentation. Forest-level analysis indicates that the great majority of the Chattahoochee National Forest occurs within a landscape that is more than 70 percent forested (USDA Forest Service 2004a). In these forest-dominated landscapes, edge effects are not expected to significantly influence productivity of interior forest species. The Cooper Creek area and surrounding National Forest lands provides an abundance of interior forest habitat and these habitats are common on the Forest as a whole. The availability of interior forest conditions are expected to increase through the implementation of the Forest Plan (USDA Forest Service 2004a)**.** Additional residential development may decrease the availability of contiguous forest habitat on private lands. However, there are no additional activities planned for the Cooper Creek watershed that would affect the availability of interior forests. Therefore no cumulative effects to interior forest habitat and associated species are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects - The activities included within the Proposed Action Alternative which would have an effect on Forest Interior Birds include: the Cooper Creek watershed include: 1) Oak/Oak-Pine Thinning, 2) Pine/Pine-Oak Thinning, 3) Canopy Gap Thinning, 4) Early Successional Habitat Treatments, 5) Woodland Restoration Treatments, and 6) Prescribed Burning. None of these treatments would substantially impact the availability of interior forest habitat. The greatest degree of canopy opening would occur with the approximately 250 acres of regeneration harvest to create early successional forest habitat (ESFH). This comprises less than 1 percent of the project area and as a result, the openings created by these treatments would not result in any appreciable fragmentation of the interior portions of these forested tracts.

Patches of ESFH are likely to have positive effects on juvenile birds, even those associated with forest interior habitat (Anders et al 1998). Clearcuts in a mostly forested (88%) West Virginia (Monongahela National Forest) landscape did not result in negative population effects such as those observed in areas fragmented by agricultural lands in the Midwestern U.S. (Duguay et al. 2001). Donovan et al. (1997) found that the negative impacts of edge effect (including increased nest parasitism and predation) was significantly greater in highly fragmented (less than 15% forested) landscapes than in moderately fragmented (45-55% forested) or unfragmented (more than 90% forested) landscapes in the Midwestern U.S. McDermott and Wood (2011) found that mature forest birds readily use clearcuts and two-age stands during the post-breeding period. Many of the species that require mature forest for nesting also use early succession habitat as fledglings and during molt (Anders et al. 1998. Vega Rivera et al. 1999, Marshall et al. 2003, Rush and Stutchbury 2008).

The oak/oak-pine and pine/pine-oak thinnings, and canopy gap and woodland treatments would result in an opening of the canopy in these stands. However, for the thinning and canopy gap treatments, most of the openings created by these treatments would be small and a continuous forest canopy would be maintained over the majority of the area. The woodland treatments would result in the greatest degree of canopy opening and could reduce habitat suitability for some interior forest birds.

The proposed prescribed burning also could result some changes to interior forest conditions. In a recent study on the Chattahoochee National, Rush et al. (2012), found that densities of several bird species were influenced by fire severity and time since burning. Ovenbird numbers were lower in all burn treatments than the unburned controls, most likely due to resulting canopy reduction. Densities of hooded warblers were higher in the low severity burns than moderate and high severity burns and unburned controls. However, other mature forest birds such as scarlet tanager, tufted titmouse, red-eyed vireo, black-throated green warbler, and black-and white warbler populations did not differ relative to either fire severity or time since fire. In addition, species associated with disturbance and early successional habitat such as indigo bunting and eastern towhee responded positively to fire severity. The majority of the previous and planned prescribed burns are of low to moderate severity and will have limited effects on interior forest habitat. Ovenbirds and hooded warblers are two of the most common birds detected in the breeding bird surveys of the Cooper Creek area. Although there may be some effects to populations of these interior forest species they are expected to remain abundant in the project area.

The effects of the proposed herbicide use are evaluated in detail in the Risk Assessment (Appendix F). Hazard Quotients (HQ) of 1.0 or less reflect exposure levels that are not of concern. HQs greater than 1.0 reflect exposures to possible effects to be examined more closely to see if the projected exposures need to be further mitigated or need to be avoided. Although typical HQ values for the herbicide

applications proposed in this alternative exceed 1.0 for non-accidental acute exposure from consumption of contaminated vegetation and for chronic exposures resulting from consumption of contaminated fruit and vegetation by small birds, these scenarios are unlikely and the risks of such contamination are reduced due to the following:

• Foliar treatments would be applied with backpack sprayers and applied to target stump sprouts; contamination to non-target vegetation most likely to be consumed would be minimal.
• The period in which treated vegetation (stumps sprouts and adjacent non-target vegetation) remains edible/available following treatment would be very short and would limit exposure time.
• These scenarios assume a diet composed of 100 percent contaminated fruit or vegetation from the site. The diets of birds are highly variable and include other food sources.
• Stump sprouting vegetation is targeted for treatment under foliar applications. This vegetation would not produce fruit to be consumed by wildlife species.
• For chronic exposures, scenarios assume that contaminated fruit or vegetation will be consumed for 90 consecutive days. These assumptions make scenarios highly unlikely especially in context of the other reasons stated above.
• Also, these scenarios are based on individuals.

As a result, the pesticide treatments included in this alternative would be expected to have no direct effects on forest interior birds, and a low risk of indirect effects due to potential effects on forest interior bird food sources.

Cumulative Effects - Forest interior birds and their habitats are abundant on the Forest and closed canopy forest constitutes approximately 88% of the Cooper Creek watershed. The availability of interior forest conditions on the Forest is expected to be stable or increase through the implementation of the revised Forest Plan (USDA Forest Service 2004a)**.** Bird survey data suggests that forest interior bird populations have been relatively stable or slightly increasing on the Forest during the last decade (USDA Forest Service 2012). The Cooper Creek project area provides ideal conditions for forest interior birds, and that habitat is not expected to be substantially changed as a result of this project. Therefore, this project when combined with other past, present and reasonably foreseeable future projects would not be expected to have a cumulative effect on forest interior birds.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on interior forest habitat is expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

3.13 Threatened, Endangered, Proposed, Sensitive Species and Locally Rare Species

3.13.1 Affected Environment

Species addressed in this document were chosen due to known occurrences and/or presence of habitat for the species in or near the project area. This was determined by: (1) consulting 21 years of U.S. Forest Service (FS) plant inventory records, (2) consulting Georgia Natural Heritage Program (GNHP) records, (3) consulting University of Georgia, Georgia DNR, and Forest Service fish and bat inventory records, (4) reviewing U.S. Fish and Wildlife Service (USFWS) lists for potential species in Union County, (5) ongoing discussions with GNHP, FS, and other agency biologists, (6) the references at the end of this document, and (7) the results of project-level surveys. Bat surveys

Site-specific inventories for Threatened, Endangered, Proposed, Sensitive Species (TESP) and Locally Rare Species (LR) occurred during the 2014 and 2015 field seasons (May-August). Access roads and adjacent stands also were surveyed. In general, only stands proposed for commercial or non-commercial vegetation management treatments were surveyed and therefore portion of the larger prescribed burning blocks were not surveyed.

One Federally listed plant and several locally rare plants were found during these inventories. Several known locations for TESP and LR species were identified in Forest Service records or the GNHP database for the project area. In addition, several species listed below are known to occur or have potential to occur in this portion of the Forest based on occurrence records, species distribution, and habitat preferences.

Table 3.13.1. Terrestrial Viability Concern Species known to occur or with potential to occur in the Cooper Creek project vicinity.

Scientific Name	Common Name	Status
Myotis sodalis	Indiana Bat	E
Myotis septentrionalis	Northern Long-eared Bat	T
Corynorhinus rafinesquii	Rafineque's Big-eared Bat	S
Myotis lebeii	Eastern Small-footed Bat	S
Speyeria diana	Diana Fritillary Butterfly	S
Condylura cristata	Star-nosed Mole	LR
Pituophis m. melanoleucus	Northern Pine Snake	LR
Isotria medeoloides	Small Whorled Pogonia	T
Juglans cinerea	Butternut	S
Carex manhartii	Manhart's sedge	LR
Carex scabrata	Rough sedge	LR
Cladrastis kentuckea	Yellowwood	LR
Cypripedium parviflorum	Yellow lady's slipper	LR
Dryopteris goldiana	Goldie's wood fern	LR
Listera smallii	Kidney-leaved twayblade	LR
Lygodium palmatum	Climbing Fern	LR
Panax trifolius	Dwarf ginseng	LR
Prosartes maculatum	Spotted mandarin	LR
Prunus virginiana var. virginiana	Chokecherry	LR

Indiana Bat – The range of Indiana bat includes much of the Midwest, portions of New England, southeast and the south-central states, with accidental/non-regular occurrences outside this range. The majority of the population hibernates at relatively few sites, including several caves and one mine in Indiana, Missouri, Kentucky and Illinois. About 85% of the total population hibernates in nine Priority 1 caves (NatureServe 2015). Since 2010, the white-nose syndrome (WNS) epizootic has caused the mortality of thousands of Indiana bats, and the "degree of threat" category in the species' Recovery Plan has been elevated from "moderate" to "high". The "high" category means extinction is almost certain in the immediate future. WNS, disturbance within hibernacula, and forest fragmentation (including conversion to urban land uses) are the most significant rangewide threats (USFWS 2009).

There are no extant hibernacula in Georgia but several exist in western North Carolina, eastern Tennessee, and northern Alabama (USFWS 2007). Until 2012, this species had been documented in Georgia from only two caves in Dade County in the northwestern part of the state (Georgia Department of Natural Resources 1999), but these have been classified as Priority 4 caves (low priority for protection) because of they are currently unoccupied by the species (U.S. Fish and Wildlife Service 2007). Prior to 2012, no summer or maternity habitat utilization had been documented in Georgia. In April 2012, a radio-transmittered female Indiana bat was aerially tracked from a hibernaculum in White County, Tennessee to Rich Mountain WMA in Gilmer County, Georgia. The site is located on state lands, approximately 2 miles south of the Chattahoochee National Forest boundary. The female bat and 12-15 unknown others were documented roosting under loose bark in shortleaf pine snags and one white pine snag for approximately 10 days in April-early May. This indicates that suitable summer/maternity habitat is likely to be present in north Georgia, but the extent of this is unknown. The forests of north Georgia/north Alabama represent the southern edge of the summer range of Indiana bats, and population densities are likely to be extremely low.

Mist net surveys in the Rich Mountain area in June, July, and August of 2012 failed to capture any additional Indiana bats. Additional mist netting surveys have occurred in the summer of 2015 throughout north Georgia and to date no additional Indiana bats have been captured.

Maternity sites generally are behind loose bark of dead or dying trees or in tree cavities. In the southern Appalachian region, maternity colonies are often located in sun-exposed conifer snags (Britzke at al. 2003). Females establish primary maternity roosts under the sloughing bark of dead yellow and white pines and eastern hemlock. In the southern portion of its range, both males and females of this species prefer yellow pine snags (with loose bark patches) for roosting (Joy O'Keefe, Indiana State University, and Susan Loeb, Southern Research Station, U.S. Forest Service, personal communication). Single bats may use a variety of tree species for roosts, as long as there is available sloughing bark or crevices on those trees (NatureServe 2015).

The forests of North Georgia represent the southern edge of the range of Indiana bats, and summer roosting/possible maternity habitat in this region differs from summer habitat in the core of the range. Preferences for open-canopied, patchy stands with yellow pine snags have been documented within this region. The typical roost tree is a large yellow pine snag on a southern aspect, with an open canopy above the roost location, at an advanced stage of decay (most bark already gone) (Joy O'Keefe, unpublished information). Contiguous forested habitat and snags are plentiful on the Chattahoochee National Forest, but stand densities are typically high and closed-canopied, and yellow pine snags and

the availability of native yellow pine species other than Virginia pine is somewhat limited due to fire suppression and other past land use practices.

Bat acoustic data sampling and mist netting was conducted in 2014 north of the Cooper Creek Watershed project area along US Highway 76 between Blairsville and Young Harris in association with a Georgia DOT project (US 76 widening). Seven sites were sampled using mist net acoustic sites sampling. A total of 18 bats comprising five species were captured over 17 nights. No Indiana bats were captured. At total of 4,460 call files were recorded during acoustic surveys at 7 sites over 17 sampling nights. BCID and EchoClass software were utilized to analyze the calls. The BCID software programs identified 4 calls (0.15%) as potential Indiana bat calls. None of the calls were identified as potential Indiana Bat calls using the EchoClass software. An additional 101 calls (2%) were identified as undistinguishable *Myotis* spp. calls (unpublished Ecological Solutions report to GDOT, 2015).

Bat acoustic survey data also was collected in the summers of 2012-2014 on a 30-mile driving route through the Cooper Creek Watershed. No Indiana bat calls have been recorded on any of these surveys (Georgia DNR Non-Game Section unpublished data). However, two calls (<1%) were identified as undistinguishable *Myotis* spp. calls.

The combined acoustic survey data and the mist netting capture data in nearby, in similar habitat indicates that the likelihood that Indiana bats are present in the Cooper Creek project area is extremely low as to be discountable (Jimmy Rickard, USFS Biologist pers. comm.).

Northern long-eared Bat - Northern long-eared bat's (NLEB) range is widespread across much of Canada and the US, but it is unevenly distributed and rarely found in large numbers. It is considered more common in the northern part of its range (Fed Register 2015). Its numbers have been reported to have declined dramatically in some parts of its range (USFWS 2014). NLEB was listed as Threatened in April 2015. Population estimates may be inaccurate due to the difficulty of surveying this species in caves (species' use of cracks and crevices in caves) and the possibility that NLEBs are hibernating in unknown locations. In Georgia, NLEB is found throughout the northern third of the state and three hibernacula are known (Polk, Rabun, and Walker Counties. NLEBs typically hibernate in caves, mines, or tunnels with significant cracks or crevices. During summer, NLEBs roost singly or in small colonies in cavities, underneath bark, crevices, or hollow live trees or snags, and occasionally structures such as barns. NLEBs are known to use multiple tree roosts within a core roost tree network (Silvis et al. 2014).

The Chattahoochee National Forest is within the range of the species in Georgia, and many summer occurrences have been documented. It is likely that NLEBs are present in the Cooper Creek project area during the summer roosting/maternity season. Bat acoustic data sampling and mist netting was conducted in 2014 north of the Cooper Creek Watershed project area along US Highway 76 between Blairsville and Young Harris in association with a Georgia DOT project (US 76 widening). Seven sites were sampled using mist net acoustic sites sampling. A total of 18 bats comprising five species were captured over 17 nights including six NLEBs. Two of the potential Myotis calls were identified as NLEB sequences (unpublished Ecological Solutions report to GDOT, 2015). No NLEB calls were recorded on the above-referenced 30-mile driving route during summer 2009-2014 (Georgia DNR Non-Game Section unpublished data). However, two calls (<1%) were identified as undistinguishable *Myotis* spp. calls.

NLEB was originally proposed for federal listing as endangered on October 2, 2013, one of two species petitioned for listing due to potential impacts of white-nose syndrome (WNS). Public comments and additional information resulted in a proposal to list the species as a threatened species with a species-specific rule under section 4(d) of the Act, excepting specific forms of take (Federal Register 2015). A final listing of the species as threatened with an interim 4(d) rule was made on April 2, 2015. The interim 4(d) rule adopted the take prohibitions at 50 CFR §17.31 and §17.32 for this species with certain exceptions. These exceptions include forest management and other specifically defined activities. Take resulting from these activities is exempt from the take prohibitions provided that the activities:

- occur more than 0.25 mile (0.4 kilometer) from a known hibernacula;
- avoid cutting or destroying known, occupied maternity roost trees during the pup season (June 1-July 31); and
- avoid clearcuts and similar harvest methods within 0.25 mile of known, occupied maternity roost trees during the pup season (June 1- July 31).

The Forest Service, Region 8, submitted a Biological Assessment (BA) for Activities Affecting NLEB on Southern National Forests to the US Fish and Wildlife Service. The BA was in support of the Forest Service's determination that the implementation of the various Forest Plans by National Forests in Region 8 may adversely affect the NLEB; however, although various forest management activities may incidentally take NLEB, the Forest Service is perpetuating forested habitat in the action area, and asserts that existing standards, guidelines, and best management practices in Forest Plans are likely to improve roosting and foraging habitat and minimize the incidental take of the species. The BA provided a description of activities implemented under Forest Plans that may affect the NLEB, including the maximum annual acreage anticipated for these activities on each Forest that would achieve the objectives of the Plans consistent with their standards and guidelines. The Forest Service, Region 8, has now received a programmatic Biological Opinion (BO) from the USFWS (USFWS 2015). This BO addresses the effects to NLEB resulting from continued implementation of Forest Plans and their associated projects on 15 National Forests and 1 National Recreation Area in the Southern Region. This includes timber harvest and associated temporary road construction or reconstruction, prescribed burning, trail construction, and non-timber clearing. The BO concluded that the implementation of the Forest Plans is likely to adversely affect NLEB, but is not likely to jeopardize the continued existence of the species.

Project-level activities (such as the actions proposed in the Cooper Creek project area) that are implemented consistent with the actions in the BA are exempt from further consultation with the USFWS provided they are consistent with the conservation measures of the interim 4(d) rule, summarized above. None of the actions proposed in the Cooper Creek project are within 0.25 mile of known, occupied hibernacula or maternity roost trees.

Eastern Small-footed Bat- The Eastern small-footed bat ranges from New England, southeastern Ontario, and southwestern Quebec south and west to southeastern Oklahoma, Arkansas, northern Alabama, northern Georgia, and northwestern South Carolina (NatureServe 2015). Eastern small footed bats primarily hibernate in caves and mine tunnels during winter months. After emergence from winter hibernacula, this species typically flies short distances to its summer foraging habitat which includes stream bottoms and/or hilly or mountainous terrain in or near deciduous, evergreen or mixed forests (NatureServe

2015). During summer months, this species prefers to roost in bridges, talus slopes, between tree bark crevices and rock crevices (S. Loeb, Southern Research Station Scientist, pers. comm.).

Until recently, it was known from a very limited number of historic locations in Georgia. This included a 1950 record at the old Toccoa Experiment Station near the confluence of Mulky Creek and Cooper Creek. However, this species has recently been found roosting under rocks in the summer on open rocky outcrops in Rabun, Union, White, Lumpkin, Towns, and Habersham counties (Trina Morris, GA DNR Biologist, pers. comm.). This include several rocky summits within 5 miles of the project area.

Rafinesque's big-eared bat - There are historic records for Rafinesque's big-eared bat from Fannin and Union Counties (GNHP database). This includes a 1951 record at the old Toccoa Experiment Station near the confluence of Mulky Creek and Cooper Creek. Laerm (1981) reported historic records from Fannin, Union, Towns, and Rabun Counties in northern Georgia and several counties in the Coastal Plain, but indicated that this species was reconfirmed from only one locality on the coast (Floyd's Island) in extensive surveys throughout the state. More recently, Menzel et al. (1998) reported Rafineque's big-eared bat from old mines in Fort Mountain State Park in Murray County, Georgia.

In the summer of 2001 and 2002, Dr. Susan Loeb from Clemson University conducted bat mist netting across the Chattahoochee National Forest including several sites on the Blue Ridge Ranger District (Loeb 2001). Dr. Loeb also mist netted areas near known records of the Rafinesque's big-eared bat. The only Rafinesque's big-eared bat collected during this sampling was from eastern Rabun County near the South Carolina State line. Additional mist netting surveys have occurred in the summer of 2013-2015. No big-eared bats were found during any of the mist netting on the Blue Ridge Ranger District.

The Rafinesque's big-eared bat hibernates primarily in caves and old buildings, usually near permanent water (Webster et al. 1985). Harvey (1992) states that maternity colonies are primarily found in old buildings, and are rarely found in caves and mines. There are no caves, mines, or old buildings present in the project area and therefore it does not provide hibernation or maternity habitat.

In the summer, male big-eared bats may roost in hollow trees (Harvey 1992). Hollow trees are common throughout the Forest and are associated with older forests, typically greater than 60 years of age. There are approximately 680,000 acres of these older Forests on the Chattahoochee-Oconee National Forest. Suitable summer roosting habitat for this species occurs within the project area.

Diana fritillary - The Diana fritillary occurs throughout the Southern Appalachians, inhabiting pine and deciduous forests near streams. Violets serve as the host plant for larvae (Scott 1986). Opler (1992) states that males may use a variety of habitats, but primary habitat consists of openings and fields in wet, rich woods. Roads and other openings in moist woods provide nectar plants for this butterfly (Broadwell 1993). Many of the nectar plants are associated with early successional habitats or forest edges. There are historic reports of this species in White, Union, Fannin, Habersham, and Rabun Counties (Harris 1972). It has been observed in a variety of habitats throughout the Forest for the past 15 years (C. Wentworth, pers. comm.). Breeding habitats are primarily mesic, deciduous or mixed forests where numerous violets occur in the understory (NatureServe 2015). Because the butterfly uses a variety of forest types including both pine and hardwood forests of varying successional stages, nearly the entire Forest (750,000 acres), including the stands in the project area provide suitable habitat.

Star-nosed mole - The star-nosed mole is associated with moist swampy habitats such as marshes, bogs, seeps, and streams in both forested and early successional communities. Burrows near wet habitats may open directly into the water. Nests are constructed in burrows above water level (Webster et al. 1985, Laerm 1995). There are no records of this species in the vicinity of the project area, but it could be found in association with the seeps and small streams in the area.

Northern pine snake - The northern pine snake is known from Rabun, Fannin, Gilmer, Dawson, Cherokee, Habersham, Stephens, White, Banks, Paulding, Pickens, Cobb, Gwinnett, and Whitfield Counties (Jensen et al. 2008). It recently has been found in northern Union County (John Jensen, pers. comm.) This secretive species requires dry, often sandy soil for construction of their burrows, where they spend much of their time underground (Mount 1975, Martof et al. 1980, Wilson 1995). Eggs are laid in nests located in cavities or burrows that are several inches below ground (Mount 1975). The pine snake's diet consists primarily of small mammals (Martof et al. 1980). The northern pine snake is found in dry, upland forests such as those found on the in portions of the Cooper Creek project area.

Small Whorled Pogonia - Sixteen populations of small-whorled pogonia are known from the Chattahoochee National Forest (USDA For Serv. 2004a) Populations range in size from 1 plant to approximately 50 individuals. Small whorled pogonia historically is known for 4 sites in the project area although no plants have been found at these sites in recent surveys. The plant is found primarily in second and third-growth deciduous and mixed-pine hardwoods (USFWS 1992). Ages of older trees in orchid sites across the region vary from approximately 30 years in South Carolina to 80 years in Virginia. Habitat is highly variable, but is generally mesic with an open understory, often with old logging roads and streams nearby. The plant appears to be a mid-successional species, and declines appear to be related to succession of the surrounding forest. Many of the populations are so small, they may not be self-sustaining regardless of habitat conditions. One new small population of small whorled pogonia was found during the botanical inventories of the project area.

Butternut – This tree is occurs in moist, nutrient rich forests from New Brunswick west to Minnesota, south to northern Georgia and Arkansas. This tree, formerly common, is afflicted with butternut canker disease, which now threatens its continued existence (Weakley 2007). This species was observed in 3 stands in the Cooper Creek project area in the recent inventories.

Manhart's sedge – This sedge is endemic to the Blue Ridge Mountains in western North Carolina, southwestern Virginia, northeast Georgia, and southeast Tennessee (Weakley 2007). It is found in cove forests and montane oak-hickory forests, mostly at medium to fairly high elevations. Once considered very rare, this species is now known to be locally common in portions of southwest North Carolina and adjacent northeast Georgia (Weakley 2007). Over 40 populations have been found in the Chattahoochee National Forest in the past 10-15 years. This species was observed in 4 stands in the Cooper Creek project area in the recent inventories.

Rough sedge – The rough sedge is considered secure across its range which extends from Canada, down through New England, into the southeast. The primary threat to conservation of the plant is wetland drainage (NatureServe 2015). This species was observed stream channels in 4 stands in the Cooper Creek project area in the recent inventories of the project area.

Yellowwood – Yellowood is a small to large tree has a native range primarily in the Southern Appalachians, the Ozarks, and limestone regions in-between ranging from southern Ohio, Indiana, and

Missouri south to the Carolinas, Georgia, Alabama, Arkansas, and Oklahoma (Weakley 2007). It is often associated with calcareous or mafic rocks. It is considered vulnerable in Georgia due to the limited number of populations. This species was observed in 6 stands in the Cooper Creek project area in the recent inventories.

Yellow Lady's Slipper- The Yellow Lady's Slipper is considered secure across its range which extends from Alaska to Nova Scotia, south to Nebraska and Georgia (NatureServe 2015). Yellow lady's-slipper once occurred in nearly all Piedmont and mountain counties of Georgia. Habitat destruction and poaching have greatly reduced the number of populations, perhaps to fewer than 100. Most remaining sites are in the Chattahoochee National Forest (Jensen and Humphries 2007). This species was observed in 2 stands in the Cooper Creek project area in the recent inventories.

Goldie's Wood Fern - The Goldie's Wood Fern ranges from New Brunswick southeast to Tennessee, Alabama and Georgia, and west to Minnesota (NatureServe 2015). It is typically associated with boulderfield forests, rich cove forests, seepage swamps, especially over calcareous sedimentary or mafic metamorphic or igneous rocks (Weakley 2007). This species was observed in 1 stand in the Cooper Creek project area in the recent inventories.

Kidney-leaved twayblade – This orchid is an Appalachian endemic, ranging from Pennsylvania to North Carolina, Tennessee, and Northern Georgia (NatureServe 2015). In Georgia, is typically is found in shady rhododendron thickets with moist, acid soils, near streams (Chafin 2007) Less than 10 populations are known from Georgia, all on the Forest. This species was observed in 4 stands in the Cooper Creek project area in the recent inventories.

Climbing Fern – This species is found in bogs, moist thickets, swamp forests, in strongly acid soils. It is widespread in eastern North America, but uncommon or rare in most of its range (Weakley 2007). This species was observed in an old roadbed in 2 stands in the Cooper Creek project area in the recent inventories.

Dwarf Ginseng – This species ranges from Georgia, north to Nova Scotia and west to Ontario and Minnesota. It is rare in Georgia, North Carolina, Virginia, and Indiana (Chafin 2008). In Georgia it is known from less than 10 locations, all on National Forest or state conservation lands. It is found in rich, moist hardwood forests. One small population of this locally rare species was found in the recent inventories of the project area.

Spotted Mandarin The range of this species is restricted mainly to the Appalachian highlands in West Virginia, Kentucky, Virginia, Tennessee, North Carolina, Alabama, and Georgia, plus a disjunct range in southern Ohio on the Allegheny Plateau physiographic province (NatureServe 2015). It is generally found in nutrient-rich deciduous forests, especially cove forests and is considered rare or uncommon throughout its range (Weakley 2007). This species was observed in 2 stands in the Cooper Creek project area in the recent inventories.

Chokecherry – This species ranges from Newfoundland and Labrador west to Manitoba, south to western North Carolina, north Georgia, Arkansas and Oklahoma (Weakley 2007). It is common in the northern part of its range but rare further south. It forms clonal thickets in oak and northern hardwood forests. One population of this locally rare species was found in the recent inventories of the project area.

3.13.2 Effects on Threatened, Endangered, Proposed, Sensitive Species and Locally Rare Species

Measure: Effects on Threatened, Endangered, Proposed, Sensitive Species and Locally Rare Species and their habitats from project activities.
***Bounds of Analysis*: – Spatial:** the Cooper Creek Watershed Analysis Area includes is approximately 34,000 acres National Forest and adjacent private lands. **Temporal:** Approximately 10 years following implementation.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct impacts to Threatened, Endangered, Proposed, Sensitive Species and Locally Rare Species and their habitats are expected.

Bat Species - Ongoing dormant season prescribed burning would not have any direct impacts on the Indiana Bat, northern long-eared bat, small footed-bat, or Rafineque's big-eared bat. During this period, the bats would be located in their winter hibernacula and would not be present in the project area. Prescribed burning could indirectly affect this species due to the loss of some potential roosting and maternity colony snags. However, fire would also create new snags and additional roosting habitat, offsetting any potential losses. Overall, indirect effects from dormant season prescribed burning likely would be beneficial by improving roosting and foraging habitat for the 4 bat species.

Diana Fritillary - If Diana Fritillary were present in the area, they would be present only in the larval (caterpillar) stage at the time of year the prescribed burn would occur. At the end of summer, Diana fritillary eggs are laid next to dried-up violets where they hatch in the fall. The young caterpillars overwinter in the duff without feeding until spring, when they begin feeding on the adjacent violets (Opler 1992). Diana larvae overwinter deep in the duff, and are unlikely to be impacted by dormant season prescribed burns (Adams, pers. comm. with C. Wentworth). The fuel conditions would result in a mosaic pattern of burned area (i.e. portions of the area would not be burned). Therefore, this dormant season burn, which remove only the upper litter layers, should not impact this species. In addition, strteams roads, and existing bladed line will be used for much of the control lines so new ground disturbance will be minimal. Prescribed burning during the dormant season would not harm any larval and nectar plants since the above ground portions would not be present, and the dormant season burn would not damage the root systems. Moreover, observations by Campbell et al. (2007) suggest that disturbances like prescribed burning and mechanical treatments should increase the amount and diversity of nectar resources available to Diana fritillaries.

Star-nosed Mole - There are no records of the star-nosed mole in the vicinity of the Cooper Creek Project Area. The project area does not contain any marsh or bog habitat, but this species could be found in association with the small streams in the area. With dormant season burning, fire intensity in riparian areas is generally very low and in many cases, these areas do not burn at all. Therefore, dormant season will have no impacts to the star-nosed mole.

Northern Pine Snake - The northern pine snake is found in dry, upland forests such as those found in portions of the Cooper Creek project area. This species spend much of their time underground. Therefore, ongoing dormant season prescribed burning activities would have no direct impacts on this snake, which, if present, would likely retreat to its burrow. Continued burning could result in the opening of the canopy and increase in herbaceous vegetation. This would likely increase habitat for the small rodents serving as prey for the pine snake.

TESP and Locally Rare plants – The majority of the rare plant locations , including the small whorled pogonia site are located outside of the prescribed burning units and will not be affected. In addition, since the ongoing prescribed burns in this alternative will occur during the dormant season, there will be no direct impacts to any of the herbaceous species located in the burn units since will not be above-ground at that time. One population of yellowwood is in the areas to be prescribed burned. However, these plants occur in very moist habitats on north-facing slopes where fire intensity is expected to be very low. As a result, this species will not be impacted by these ongoing burns.

Cumulative Effects - There are no additional actions planned in the vicinity of the Cooper Creek Project Area that would adversely affect viability concern species. Surveys have been and continue to be conducted in portions of the Forest to determine presence and distribution of various small mammals, birds, amphibians and reptiles, aquatic species, and PETS and Locally Rare plants. The Georgia National Heritage Program (GNHP) records are checked for known occurrences of PETS and Locally Rare species in project areas, and close contact is maintained between the GNHP biologists and Forest Service biologists for sharing of new information. Forest Service records and other agencies' biologists and records (in addition to GNHP) are consulted for occurrences.

Future management activities and project locations will be analyzed utilizing any new information available on viability concern species. For Sensitive and Locally Rare species, mitigating measures will be implemented where needed to maintain habitat for these species on the Forest and to prevent future listing under the Endangered Species Act.

Alternative 2: Proposed Action

Direct and Indirect Effects

Indiana Bat- As discussed above, the Cooper Creek project area is unlikely to be currently occupied by roosting or maternity colonies of Indiana bats. This area is approximately 25 miles from the only known Indiana bat summer colony ever documented in Georgia. The above described mist netting and acoustic survey data collected in the area since 2012 has not documented this species in the area. This project is not likely to adversely affect Indiana bats or their roosting/maternity habitat because the likelihood of their use of the area is discountable.

Northern Long-eared Bat

It is likely that NLEBs are present in the Cooper Creek project area during the summer roosting/maternity season. There is a possibility that timber harvest and growing season prescribed burning may directly affect NLEBs due to the destruction of roost trees being utilized during the summer months, when females and their non-volant young are present. This likelihood is low in areas of extensive, intact forest habitat, where a small percentage of the area may be affected by vegetation

management activities. This likelihood is further mitigated by the retention of riparian buffers, snags, and some of the mature trees in a harvested stand.

In order to minimize the effects of forest management activities on the Indiana Bat, as well as all other Federally-protected Bat species, an amendment the Forest Plan (2004) has recently been proposed to protect habitat components for these species. These new and modified standards would be applied to this project in order to protect habitat for the Northern Long-eared Bat. These include:

- No cutting of snags >6 inches DBH.
- In all silvicultural treatments, retention priority is given to the largest available trees with favorable characteristics as bat roost trees (yellow pines and oaks with crevices, cracks, or hollows).
- In even-aged regeneration, create 5 snags per acre if not present.
- In even-aged regeneration stands larger than 10 acres, maintain a minimum of 15 sq. feet of basal area. These can be arranged in clumps, corridors, or feathered edges.
- In stands over 10 acres treated as seed-tree or shelterwood with reserves, maintain a minimum of 20 sq. feet of basal area. Retain all trees within 20 feet of 5 snags per acre for windthrow protection and snag recruitment.
- All shagbark hickory trees would be retained.
- Protect known bat roosts from cutting or modification as long as suitable.

Forest management can both positively and negatively affect bat habitat (Starbuck et al. 2014). These standards would mitigate effects of harvest activities and even improve habitat conditions for tree-roosting bats, including NLEB. NLEBs have been documented preferentially utilizing thinned stands for roosting (Perry et al. 2007). This species is known to switch tree roosts and utilize multiple tree roosts (O'Keefe 2009). This roost-switching behavior is consistent with colonial species of bats and can define their social structure (fission-fusion societies) (Silvis et al 2014). It is also consistent with the ephemeral nature of snags on the landscape (Silvis et al 2015).

Landscape-level prescribed fire of 11,842 acres across 9 burn units is proposed under this Alternative. Prescribed burning in the dormant season while NLEBs are hibernating would not result in direct effects to the species, but fire has the capacity to both create and destroy snags (Smith 2000). This could indirectly affect NLEBs by affecting the availability of snags or roost tree networks within individual burn units. Overall, this activity would not affect the availability of these elements in the project area due to the abundance of late-successional forest habitat.

Growing season prescribed burning could both directly and indirectly affect NLEBs. Direct effects on NLEB include heat, smoke, and modification of habitat components such as roost trees. Direct mortality is unlikely for adult NLEBs, which commonly roost-switch in response to disturbance or for unknown reasons, but loss of non-volant pups due to growing season fire is a possibility, although remote in a forested landscape of the scale involved in the project area. Indirect effects of growing season prescribed fire would likely include both the creation and destruction of snags, the creation of more open forest stands, the decrease of understory woody vegetation, which has been negatively associated with NLEB preferred habitat (Starbuck et al. 2014), and the improvement in the insect prey base for bat foraging. This has been shown to increase in burned areas (Cox and Widener 2008).

There would be no direct effects of the proposed pesticide treatments on NLEBs and a low risk of indirect effects because of potential effects on food sources that they might consume (flying insects,

such as moths, flies, leafhoppers, caddisflies, and beetles). Both the acid and the ester formulations of triclopyr are relatively non-toxic to terrestrial vertebrates and invertebrates (Tu et al. 2001). The effects of the proposed herbicide use are evaluated in detail in the Risk Assessment (Appendix F). The hazard quotients (HQ) are less than 1.0 for mammals consuming contaminated insects under an acute non-accidental exposure scenario indicating low risk.

In summary, this project is likely to adversely affect the northern long-eared bat; however, there are no effects beyond those previously disclosed in the programmatic biological opinion dated August 5, 2015 (FWS Log #04E00000-2015-F-0003). Any taking that may occur incidental to this project is excepted from the prohibitions for taking threatened species under 50 CFR 17.31 and 17.32. This project is consistent with the forest plan, the description of the proposed action in the programmatic biological opinion, and activities excepted from taking prohibitions under the ESA section 4(d) rule applicable to the northern long-eared bat; therefore, the programmatic biological opinion satisfies the Forest Service's responsibilities under ESA section 7(a)(2) relative to the northern long-eared bat for this project.

Eastern Small-footed Bat - Under this alternative, prescribed fire and tree cutting during the summer roosting/maternity season are the primary actions which would directly and/or indirectly affect this species. In addition, any tree cutting or prescribed fire which takes place outside of the summer roosting/maternity season has the potential to indirectly affect this species through modification of habitat.

Any burning after April 1 has the potential to directly impact the Eastern Small-footed bat during the summer roosting/maternity season. Direct effects would occur either through heat or smoke inhalation. However, the beneficial effect prescribed fire would have on this species' habitat would outweigh the potential negative effect of directly impacting the species. Likewise, although the proposed prescribed fire may indirectly affect this species by consuming some potential roosting and maternity colony snags, the beneficial effect of prescribed fire to restore and maintain open canopy pine and oak habitat conditions would outweigh the indirect effects of burning down snags, especially considering new snags would also be created through prescribed fire activities. In addition, the prescribed fire units which include the rock outcrops would be especially important for this species, as these rock outcrops are suffering from the shading effects of fire exclusion. Prescribed burning in these areas would result in mortality to trees that are currently shading the outcrops, and make these sites more favorable as roosting/maternity habitat for this species (T. Morris, GA DNR Biologist, pers. comm.).

Vegetation management treatments (tree cutting) conducted after April 1 would also have the potential to directly affect this species by cutting some large diameter trees which could potentially be occupied by the species. However, as discussed above, additional measures to protect snags and potential roost trees during vegetation management treatments will be incorporated into this project. In addition, the beneficial effects of decreasing canopy closure through the vegetation management activities included in this alternative would outweigh the possibility of negatively affecting the species. Similar to prescribed fire, thinning the forest and retaining large trees, as proposed with this project, would increase the degree of exposure of some potential maternity roost trees to solar radiation – providing improved thermal conditions for raising young during a wide range of weather conditions. In addition, creation of early successional habitats with an open understory and patchy overstory would create insect rich foraging areas and flight corridors leading to potential roost trees. Vegetation management

would produce a mosaic of successional stages within the Cooper watershed that would ultimately benefit this species.

The effects of the proposed herbicide application on insectivorous bats are discussed above in the NLEB section. The hazard quotients (HQ) are less than 1.0 for mammals consuming contaminated insects under an acute non-accidental exposure scenario indicating low risk.

Rafinesque's Big-eared Bat - Although there is a historic record of the Rafinesque's big-eared bat in the vicinity of the Cooper Creek project area it has not been reconfirmed in recent surveys. However, hollow trees that serve as summer roosts for male bats are common throughout the Forest and are associated with older forests, typically greater than 60 years of age. There are approximately 680,000 acres of these older Forests on the Chattahoochee-Oconee National Forest and over 20,000 acres in the Cooper Creek analysis area. The Forest plan contains a standard that provides for protection of existing snags and den trees during vegetation management treatments and as discussed above, additional measures to protect snags and potential roost trees treatments will be incorporated into this project. As a result, hollow trees would not be cut or intentionally disturbed. Even if a hollow tree is inadvertently damaged, roosting bats are quick to fly away when disturbed on the roost (Ozier 1999), and would promptly relocate (M. Bunch SCDNR, pers. comm. with A. Gaston).

Although the proposed prescribed burning could damage some hollow trees, given their abundance on the Forest, the availability of summer roost trees would not be affected. Through time, repeated prescribed burns would result in fire scarring of the residual trees that would lead to the development of additional hollow trees, offsetting any losses of existing potential roosts. The overall effect on habitat for the species could be beneficial, by promoting open canopied forest conditions and improved foraging habitat (Greenberg and Loeb 2014; Greenburg et al. 2013; Moorman et al. 2011).

The effects of the proposed herbicide application on insectivorous bats are discussed above in the NLEB section. The hazard quotients (HQ) are less than 1.0 for mammals consuming contaminated insects under an acute non-accidental exposure scenario indicating low risk.

Diana Fritillary - There would be no direct effect of the proposed vegetation management on the Diana Fritillary. The proposed activities could impact larval host plants (violets) and nectar plants on the site. However nectar plants are not a limiting factor for the Diana, and flowering plants that would provide nectar for the butterfly are commonly found in all types of habitat throughout the Chattahoochee Forest, as well as on private land. In addition, many of the nectar plants likely would increase in these areas due to increased sunlight and would offset any impacts to existing plants.

Both dormant season and growing season prescribed burning is proposed in this alternative. Existing skid trails and roads would be used for much of the control lines so new ground disturbance would be minimal. If Diana Fritillaries were present in the area, they would be present only in the larval (caterpillar) stage during the dormant season. At the end of summer, Diana fritillary eggs are laid next to dried-up violets where they hatch in the fall. The young caterpillars overwinter in the duff without feeding until spring, when they begin feeding on the adjacent violets (Opler 1992). Diana larvae overwinter deep in the duff, and are unlikely to be impacted by dormant season prescribed burns (Adams, pers. comm. with C. Wentworth). The fuel conditions would result in a mosaic pattern of burned area (i.e. portions of the area would not be burned). Therefore, dormant season burning, which

remove only the upper litter layers, should not impact this species. However, if present, young caterpillars could be impacted by a growing season prescribed burn.

Prescribed burning during the dormant season would not harm any larval and nectar plants since the above ground portions would not be present, and the dormant season burn would not damage the root systems. Existing larval and nectar plants could be impacted by a growing season burn. However, the impacts to existing plants would be offset by the herbaceous growth response following the prescribed burn. Observations by Campbell et al. (2007) suggest that disturbances like prescribed burning and mechanical treatments should increase the amount and diversity of nectar resources available to Diana fritillaries. Overall, the proposed prescribed burning and vegetation management treatments would encourage herbaceous diversity across the project area, thus greatly benefitting this species. This alternative would have a beneficial direct and indirect effect on this species.

Herbicide application also could impact nectar plants and violets necessary for the life cycle of Diana fritillary. However, as discussed above, mitigation measures would be implemented to minimize impacts to non-target plants.

Star-nosed Mole - There are no records of the star-nosed mole in the vicinity of the Cooper Creek project. The project area does not contain any marsh or bog habitat, but this species could be found in association with the small streams in the area. These sites would be protected through the application of riparian corridor standards (MRx 11) and Best Management Practices (BMPs). As a result there would be no impacts to potential habitat for the star-nosed mole.

The primary diet of the star-nosed mole is aquatic worms and insects. The hazard quotient (HQ) for small mammals with typical exposures through direct spray, and consumption of contaminated water and insects all are less than 1.0 for all herbicide applications proposed in this alternative indicating exposure levels not of concern. In addition, with the provision of riparian buffer strips on stream zones, the risk of herbicide contamination in streams is greatly reduced.

Northern Pine Snake - The northern pine snake is found in dry, upland forests such as those found on the Cooper Creek project area. However there are no records of this species from Union County or the Cooper Creek project area. This species spend much of their time underground. Therefore, the proposed thinning and prescribed burning activities would have no direct impacts on this snake, which, if present, would likely retreat to its burrow. The treatments proposed (thinning, burning, herbicide application) would result in the opening of the canopy and increase in herbaceous vegetation. This would likely increase habitat for the small rodents serving as prey for the pine snake.

Below-ground contamination and dermal absorption of herbicide by the pine snake would be unlikely due to the fact that triclopyr has limited soil mobility. The pine snake's diet consists primarily of small mammals (Martof et al. 1980). Reptiles were not evaluated in the herbicide risk assessment but hazard quotients for carnivorous mammals consuming contaminated small mammals also are well below 1.0 for all herbicide applications proposed in this alternative indicating low risk, even at upper levels of exposure.

TESP and Locally Rare Plants

One population of the Federally Threatened small-whorled pogonia is located in a stand proposed for thinning. This population will be protected from direct impacts by prohibiting logging, logging equipment, tree felling, and herbicide application within the colony site and in a buffer sufficient to maintain the exiting light regime. No prescribed burning is proposed in the stand containing this species. Therefore, there will be no impacts from this Alternative on small-whorled pogonia.

There also are one or more populations of Sensitive and Locally Rare plants in the stands proposed for vegetation management. The populations of rough sedge are located in stream channels and the populations of kidney leaved twayblade are located in rhododendron thickets on the edge of streams. Proposed activities in these areas are limited and these populations will be protected through the application of riparian corridor standards (MRx 11) and Best Management Practices. Burning intensity will be low in the riparian areas and there will be no negative impacts to these plants from prescribed burning. For the other sensitive and locally rare plants, all significant populations will be protected from direct impacts by prohibiting logging, logging equipment, tree felling, and herbicide application within the colony site and in a buffer sufficient to maintain the exiting light regime.

As discussed previously, the majority of the rare plant locations, are located outside of the prescribed burning units and will not be affected by the proposed burning. In addition, there will be there will be no direct impacts to any of the herbaceous species located in the burn units from the dormant season burns. However, burning during the growing season could impact some of these plants that are above-ground at that time. However, nearly all of these plants are associated with north-facing, mesic slopes or riparian areas where fire intensity will be low. These plants are unlikely to be impacted by burning. The exception to this is several population of climbing fern that are located along an old roadbed in a upland site. These populations will be excluded from the prescribed burn to prevent damage to these populations. As discussed above, in general, only stands proposed for commercial or non-commercial vegetation management treatments were surveyed and therefore portion of the larger prescribed burning blocks were not surveyed. Prior to implementing a growing season burn, if not already surveyed, the unit will be inventoried for rare plants and the appropriate mitigation measure will be implemented.

The herbicide application proposed in this alternative could impact these locally rare plants. However, direct effects to these plants are not likely due to the fact that herbicide will be applied to specific targeted plants either by application to the cut stump or direct foliar application. Forest Plan Standard FW- 019 prohibits the application of herbicide within 60 feet of any federally listed or sensitive species except to protect them from invasive plant competition. In addition, a project level mitigation measure has been included that provides this same 60 foot buffer distance for locally rare plants. Other Forest Plan standards also prevent impacts to non-target vegetation, such as weather restrictions to prevent drift of herbicide found in standard FW-13, and nozzle size restrictions found in FW-14.

The spread of NNIS have the potential to impact these locally rare plants as well as other native plants. However, most of the NNIS are located in different stands and/or habitats than are the locally rare plants. In addition, the proposed prescribed burning and herbicide treatments will control some of the NNIS populations.

The woody NNIS, Oriental Bittersweet, Chinese privet, and Multiflora Rose, will be treated during the post-sale herbicide application. There currently are just a few scattered individuals of these species present in the project area that should be effectively controlled with herbicides. Repeated prescribed

burns as is proposed for this project also have been shown to be effective in controlling privet (Evans et al. 2006). These actions will diminish the potential impact of these species on native plants.

Japanese stiltgrass is the most widely distributed NNIS in the project area and as a result, has the greatest potential to impact the existing locally rare plants. The primary habitat for stiltgrass is ditches, floodplains and wetlands, forest and stream edges, as well as shaded roads and trails (Evans et al. 2006). The majority of the locally rare plants are associated with mesic habitats which could provide suitable habitat for the spread of stiltgrass. However, mitigation measures described above such as excluding logging equipment and tree felling near the locally rare plants will further limit the degree of disturbance near these local rare species. The populations of rough sedge were found rooted in the water, and although stiltgrass is tolerant of saturated soil, it will not establish in permanent water (Evans et al. 2006, NatureServe 2015). In addition, growing season prescribed burning as is proposed in this alternative may help control the spread of stiltgrass (Evans et al 2006).

Cumulative Effects - There are no additional actions planned in the vicinity of the project area that would adversely affect viability concern species. The only recent vegetation management activities on Forest Service lands in this area have been prescribed burning. While prescribed burning can consume snags that could serve as roost trees for forest bats, it also results in the creation of snags and the reduction of understory clutter which benefits these species.

Surveys have been and continue to be conducted in portions of the Forest to determine presence and distribution of various small mammals, birds, amphibians and reptiles, aquatic species, and PETS and Locally Rare plants. The Georgia National Heritage Program (GNHP) records are checked for known occurrences of PETS and Locally Rare species in project areas, and close contact is maintained between the GNHP biologists and Forest Service biologists for sharing of new information. Forest Service records and other agencies' biologists and records (in addition to GNHP) are consulted for occurrences.

Future management activities and project locations would be analyzed utilizing any new information available on viability concern species. For Sensitive and Locally Rare species, mitigating measures would be implemented where needed to maintain habitat for these species on the Forest and to prevent future listing under the Endangered Species Act.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on TESP and Locally Rare species are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. The treatments in a number of the stands containing TESP or locally rare plants are dropped in this alternative or were changed to noncommercial treatments that would have minimal ground disturbance. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

3.14 Management Indicator Species

3.14.1 Affected Environment

To help evaluate the effects of management practices on plants, animals and fisheries, the Management Indicator Species (MIS) concept is used. MIS are selected and monitored because their population trends are thought to potentially be a result of the effects land management activities are having on important habitat components for those species.

The Forest Plan identifies 15 management indicator species to help indicate effects of management on some elements of this framework. A subset of these MIS is analyzed further in this analysis because their populations or habitats may be affected by the project (Table 3.14.1). For those species that also were MIS in the original 1985 Forest Plan (e.g. Acadian flycatcher, pileated woodpecker, white-tailed deer, black bear), much of the Forest-wide population and habitat data was compiled and analyzed previously (USDA Forest Service 2003b). Most of the MIS in the Forest Plan are birds that are monitored annually through the Forest's breeding bird surveys (USDA Forest Service 2004c). In addition, La Sorte et al. (2007) have recently completed an analysis of breeding bird population trends on Southern National Forests (1992-2004), which included the MIS bird species. Population trends for all of the current MIS are summarized in the Management Indicator Species Population Trend Report for the Chattahoochee-Oconee National Forests (USDA Forest Service 2006, 2012).

Table 3.14.1. Forest-level management indicator species, their purpose, whether they are selected for project-level analysis, and reasons for their selection or non-selection, Cooper Creek Project.

Species Name	Purpose	Analyzed Further?	Relevance to this Project (Potential Effects of Concern)
Prairie Warbler	To help indicate the effects of management on early successional forests	Yes	Prairie warblers occur in the vicinity of the project and management actions may affect the availability of early successional forest
Ovenbird	To help indicate the effects of management on Forest Interiors (Chattahoochee NF)	Yes	Ovenbirds occur in the vicinity of the project and management actions may affect the forest interior habitat
Wood Thrush	To help indicate the effects of management on Forest Interiors (Oconee NF)	No	Wood thrush was selected as a MIS for the Oconee NF, to help indicate the effects of management actions on forest interior habitat. The Ovenbird is used as the MIS for this habitat on the Chattahoochee NF.
Pileated Woodpecker	To help indicate effects of management on snags.	Yes	Pileated woodpeckers occur in the vicinity of the project and management actions may affect the availability of snags.
Scarlet Tanager	To help indicate the effects of management on Oak Forest	Yes	Scarlet tanagers occur in the vicinity of the project and management actions may affect the structure of oak forests
Hooded Warbler	To help indicate the effects of management on mid -late successional mesic deciduous forest	Yes	Hooded warblers occur in the vicinity of the project and management actions may affect the structure of mid-late successional mesic deciduous forests
Chestnut-sided Warbler	To help indicate the effects of management on high elevation early-successional	Yes	Chestnut-sided warblers occur in the vicinity of the project area and management actions may affect the

	Forests		availability of high elevation early successional forest
Pine Warbler	To help indicate the effects of management on Pine, Pine-Oak Forest	Yes	Pine warblers occur in the vicinity of the project and management actions may affect the structure of pine forests.
Acadian Flycatcher	To help indicate the effects of management on Mid-Late Successional Riparian Habitats	Yes	Acadian flycatchers occur in the vicinity of the project and management actions may affect the structure of forested riparian habitats.
Field Sparrow	To help indicate the effects of management on woodland, savanna and grassland communities	Yes	Field sparrows are uncommon in the vicinity of the project but management actions may affect the availability of woodland conditions.
Swainson's Warbler	To help indicate the effects of management on early successional riparian forests (Oconee NF)	No	Swainson's Warbler was selected as a MIS for early successional riparian habitats on the Oconee NF, primarily canebrakes. Habitat for this species is not present in the project area.
Red-cockaded woodpecker	To help indicate effects of management on recovery of this endangered species, and on mid-late successional pine forest community. (Oconee NF)	No	Red-cockaded woodpecker was selected as a MIS for open pine forests on the Oconee NF and do not occur on the Chattahoochee NF
Smooth Coneflower	To help indicate effects of management on recovery of this endangered species.	No	On the Chattahoochee NF, smooth coneflower is known only to occur on the Chattooga River Ranger District in Habersham and Stephens Counties.
Black bear	To help indicate effects of management on supplying public demand for bear hunting and viewing.	Yes	Tree harvest and prescribed burning under some alternatives would affect the amount of hard and soft mast for this species, potentially affecting population levels.
White-tailed Deer	To help indicate effects of management on supplying public demand for deer hunting and viewing.	Yes	Tree harvest, prescribed burning and permanent opening management under some alternatives would affect the amount of browse and cover for this species, potentially affecting population levels.

3.14.2 Effects on Management Indicator Species

Measure: Effects of alternatives on Forest-wide population trends for select Management Indicator Species.
***Bounds of Analysis*: – Spatial:** the Cooper Creek Watershed Analysis Area includes is approximately 34,000 acres National Forest and adjacent private lands. **Temporal:** Approximately 10 years following implementation.

PrairieWarbler

The Forest Plan identified the prairie warbler as a MIS to help indicate the effects of management on species associated with early successional forests. Prairie warblers are shrub land nesting birds found in suitable habitats throughout the Southern Appalachians, Piedmont, and Coastal Plain (Hamel 1992).

Prairie warblers require dense forest regeneration or open shrubby conditions in a forest setting. Near optimal habitat conditions are characterized by regeneration, thinned areas or patchy openings 10 acres or more in size (Nature Serve 2015). Typical habitat for this species includes timber harvest and prescribed burns which result in early successional forests and the restoration of open woodlands (La Sorte, et al. 2007). Populations respond favorably to conditions created 3 to 10 years following regeneration in larger forest patches (Lancia et al. 2000). Prairie warblers occur through the Forest. The prairie warbler was once a relatively common breeding bird on the Blue Ridge Ranger District and limited numbers have historically reported from Breeding Bird Surveys in the Cooper Creek project area. However, it now is an uncommon species on the District and no prairie warblers have been reported from the survey Cooper Creek survey points in the last 7 years, likely due to the limited availability of early successional habitats.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct changes to the distribution of successional habitats are expected. In general, the ongoing dormant season prescribed burns are not expected to substantially increase the availability of early successional forests. Through time, the amount of early successional habitat would decrease as these young forests mature. This should result in a reduction in the habitat availability for the prairie warbler and other species that utilize early successional habitats.

Cumulative Effects - Early successional habitats are limited on the Cooper Creek area. This habitat is somewhat more common on the Forest as a whole but has declined recently due to a reduction in forest management activities. The US Geological Survey (USGS) Breeding Bird Survey indicates a decreasing trend for this species from 1966 to 2012 in the Appalachian Mountains (Sauer et al., 2014). Similarly, analysis of breeding bird population trends on Southern National Forests (1992-2004), suggests there have been significant population decreases in prairie warbler in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data on the Chattahoochee-Oconee National Forests indicate that this species is declining, as early successional forest, woodland and savanna creation has not occurred on the Forest at the level described in the Forest Plan (USDA Forest Service 2012).
There are no additional activities planned for the Cooper Creek project area that would affect the availability of early successional forests. Therefore no cumulative effects to early successional forest habitat and associated species such as prairie warblers are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects- The vegetation management treatments and prescribed fire treatments proposed in this alternative would enhance habitat conditions for the prairie warbler and species associated with early successional forest habitats. Approximately 250 acres will be regenerated under this alternative resulting in the development of optimal early successional forest habitat conditions for species like prairie warblers. Some additional habitat will be created the portions of the areas planned for woodland restoration and/or prescribed burning where dense shrub cover is allowed to develop. In a study conducted on the Chattahoochee National Forest, Klaus et al. (2010) reported that prairie warbler and other early successional species responded positively to increased fire severity and the resulting early successional habitat.

The effects of the proposed herbicide use are evaluated in detail in the Risk Assessment (Appendix F). Hazard Quotients (HQ) of 1.0 or less reflect exposure levels that are not of concern. HQs greater than 1.0 reflect exposures to possible effects to be examined more closely to see if the projected exposures

need to be further mitigated or need to be avoided. Prairie warblers primarily feed on insects and other small invertebrates. Typical HQ values for the herbicide applications proposed in this alternative are less than 1.0 for consumption of contaminated insects by small birds indicating low risk. As a result, the pesticide treatments included in this alternative would be expected to have no direct effects on prairie warblers or other insectivorous bird species, and a low risk of indirect effects due to potential effects on food sources.

Under the action alternatives, the local populations of prairie warblers would increase. Due to the small population size of this species on the Chattahoochee-Oconee National Forests (due to limited habitat), the action alternatives included in this project could likely increase the forest- wide population trend for this species.

Cumulative Effects - Early successional habitats are limited on the Cooper Creek area. This habitat is somewhat more common on the Forest as a whole but has declined recently due to a reduction in forest management activities. This project and other similar projects on the Forest will begin to reverse this declining trend. The availability of early successional habitat and the populations of prairie warblers are on the Forest are expected to increase through the implementation of the revised Forest Plan (USDA Forest Service 2004a)**.** There are no additional activities planned for the Cooper Creek that would affect the availability of early successional forests. Therefore no cumulative effects to early successional forest habitat and associated species such as prairie warblers are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for prairie warblers and other early successional species is expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Ovenbird

The Forest Plan identified the ovenbird as a MIS to help indicate the effects of management on species associated with interior forest habitats on the Chattahoochee National Forest. Ovenbirds are strongly associated with mature forest interior habitats (Hamel 1992, Crawford et al. 1981). They generally breed in closed canopy deciduous or mixed forests with limited understory. It is commonly found in mature mesic deciduous forests (La Sorte et al., 2007). Typical forested communities where ovenbirds breed include oak- hickory and oak-pine forests. The ovenbird is a one of the common breeding bird on the Blue Ridge Ranger District including the Cooper Creek Watershed.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct impacts to interior forest habitat are expected. The ongoing dormant season prescribed burns will have

on effect on interior forest conditions. Through time, the amount of interior forest habitat would increase as the Forest matures. This should result in improved habitat conditions for the ovenbird and other species that utilize interior forest habitats.

Cumulative Effects - The US Geological Survey (USGS) Breeding Bird Survey indicates an increasing trend for this species from 1966 to 2012 in the Appalachian Mountains (Sauer et al., 2014). Analysis of breeding bird population trends (1992-2004) on Southern National Forests, suggests that ovenbird population have been stable in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data for the Chattahoochee-Oconee National Forest suggests that the ovenbird populations appear to be stable, although there are periodic fluctuations in relative abundance on the Chattooga River and Blue Ridge Ranger Districts (USDA Forest Service 2012). The Cooper Creek area and surrounding National Forest lands provides an abundance of interior forest habitat for ovenbirds and other interior forest species and these habitats are common on the Forest as a whole. The availability of interior forest conditions are expected to increase through the implementation of the Forest Plan (USDA Forest Service 2004a)**.** Additional residential development may decrease the availability of contiguous forest habitat on private lands. However, there are no additional activities planned for the Cooper Creek watershed that would affect the availability of interior forests. Therefore no cumulative effects to interior forest habitat and associated species are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects – The effects of this alternative on the ovenbird and other interior forest species was discussed in section 3.12 above and are summarized here. The effects of the proposed herbicide use on small insectivorous birds such as the ovenbird are disclosed above in the prairie warbler section. The activities included within the Proposed Action Alternative which would have an effect on ovenbirds include: the Cooper Creek watershed include: 1) Oak/Oak-Pine Thinning, 2) Pine/Pine-Oak Thinning, 3) Canopy Gap Thinning, 4) Early Successional Habitat Treatments, 5) Woodland Restoration Treatments, and 6) Prescribed Burning. None of these treatments would substantially impact the availability of interior forest habitat. The greatest degree of canopy opening would occur with the approximately 250 acres of regeneration harvest to create early successional forest habitat (ESFH). This comprises less than 1 percent of the project area and as a result, the openings created by these treatments would not result in any appreciable fragmentation of the interior portions of these forested tracts.

The oak/oak-pine and pine/pine-oak thinnings, and canopy gap and woodland treatments would result in an opening of the canopy in these stands. However, for the thinning and canopy gap treatments, most of the openings created by these treatments would be small and a continuous forest canopy would be maintained over the majority of the area. The woodland treatments would result in the greatest degree of canopy opening and could reduce habitat suitability for some interior forest birds like the ovenbird. The proposed prescribed burning also could result some changes to interior forest conditions. However, the majority of the previous and planned prescribed burns are of low to moderate severity and will have limited effects on ovenbird habitat. Ovenbirds are one of the most common birds detected in the breeding bird surveys of the Cooper Creek area. Although there may be some effects to populations of these interior forest species they are expected to remain abundant in the project area.

Cumulative Effects - The Cooper Creek area and surrounding National Forest lands provides an abundance of interior forest habitat for ovenbirds and other interior forest species and these habitats are common on the Forest as a whole. Closed canopy forest constitutes approximately 88% of the Cooper

Creek watershed. The availability of interior forest conditions are expected to increase through the implementation of the Forest Plan (USDA Forest Service 2004a)**. A**dditional residential development may decrease the availability of contiguous forest habitat on private lands. However, there are no additional activities planned for the Cooper Creek watershed that would affect the availability of habitat for ovenbirds and other interior forest species and therefore no cumulative effects are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for ovenbirds and other interior forest species is expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Pileated Woodpecker

The Forest Plan identified the pileated woodpecker as a MIS to help indicate the effects of management on species that utilize snags. Habitat consists of mature (60+ years) and extensive hardwood and hardwood-pine forest (Hamel 1992). Preferred habitat is primarily deep woods, swamps, or river bottom forests. The pileated woodpecker can also be found in rather open, upland forest of mixed forest types. This bird forages and nests on and in snags, with some foraging also occurring on fallen logs and other forest debris. This species requires snags for nesting and foraging. The pileated woodpecker is a common breeding bird on the Blue Ridge Ranger District including the Cooper Creek watershed.

Alternative 1: No Action

Direct and Indirect Effects -This alternative would perpetuate current conditions and no direct impacts to snags, dens, and downed wood are expected. The ongoing prescribed fire treatments may impact existing snags and downed wood. However, prescribed fire also is likely to increase the amount of standing snags within the project area by causing direct mortality of living trees. In addition, prescribed burning would also increase the amount of down wood by burning down some standing snags that are present prior to the burn. Overall, the quantity of available snags is expected to increase over time as a result of the periodic prescribed burns. Through time, the amount of mid-late successional habitat would increase as the forests in the area mature. This should result in improved habitat conditions for the pileated woodpecker and other species that utilize snags, dens, and downed wood.

Cumulative Effects - Recruitment of snags, dens, and downed wood is most dependent on providing abundant late successional forests. The availability of these habitats and populations of pileated woodpeckers and associated species are expected to increase through time with the implementation of the Forest Plan (USDA Forest Service 2004a). The Forest plan has several standards that ensure the retention and recruitment of snags and den trees. The US Geological Survey (USGS) Breeding Bird Survey indicates an increasing trend for this species from 1966 to 2012 in the Appalachian Mountains (Sauer et al., 2014). Similarly, Analysis of breeding bird population trends on Southern National

Forests (1992-2004), suggests there have been population increases in pileated woodpeckers in the Southern Blue Ridge (La Sorte et al 2007). Breeding bird monitoring data on the Chattahoochee-Oconee National Forests indicates an increasing forest-wide population trend for this species, (USDA Forest Service 2012). There are no additional activities planned for the project area that would affect the availability of snags, dens, or downed wood. Therefore no cumulative effects to these habitat elements and associated species such as pileated woodpeckers are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects – Pileated woodpecker populations are largely influenced by the availability of snags. The effects of this alternative on the snags were discussed in section 3.10 above and are summarized here. The effects of the proposed herbicide use on small insectivorous birds such as the pileated woodpecker are disclosed above in the prairie warbler section. The activities included within the Proposed Action Alternative which could have an effect on snags and populations of snag dependent species such as the pileated woodpecker within the Cooper Creek watershed include: 1) Oak/Oak-Pine Thinning, 2) Pine/Pine-Oak Thinning, 3) Canopy Gap Thinning, 4) Early Successional Habitat Treatments, 5) Woodland Restoration Treatments,6) Release Treatments, 7) Midstory Treatments, and 8) Prescribed Burning. However, Forest-wide standards would be followed that ensure the retention and recruitment of these habitat elements on the landscape. Commercial timber harvest operations would be prescribed in a manner to provide adequate snags, down wood and den trees. In the thinning and other intermediate timber operations, existing snags and den trees would be retained. Some additional snags, den trees, and downed woody debris may be created as a result of timber harvest operations during these treatments. The prescribed fire treatments proposed in this alternative may impact existing snags and downed wood. However, prescribed fire also is likely to increase the amount of standing snags within the project area by causing direct mortality of living trees. In addition, prescribed burning would also increase the amount of down wood by burning down some standing snags that are present prior to the burn. Overall, the quantity of available snags is expected to increase over time as a result of the periodic prescribed burns.

Cumulative Effects - Recruitment of snags, dens, and downed wood is most dependent on providing abundant late successional forests. The availability of these habitats and populations of pileated woodpeckers and associated species are expected to increase through time with the implementation of the Forest Plan (USDA Forest Service 2004a). The Forest plan has several standards that ensure the retention and recruitment of snags and den trees. The actions proposed in this alternative coupled with ongoing prescribed burning and other past, present and reasonably foreseeable future actions are likely to increase the amount of snags within the watershed. Tree mortality from hemlock woolly adelgid and other insect and disease outbreaks also will provide for the recruitment of snags. This would benefit populations of pileated woodpeckers and other snag dependent species. There are no additional activities planned for the project area that would affect the availability of snags, dens, or downed wood. Therefore no cumulative effects to these habitat elements and associated species such as pileated woodpeckers are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for pileated woodpeckers and other snag dependent species is expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the

proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Scarlet Tanager

The Forest Plan identified the Scarlet Tanager as a MIS to help indicate the effects of management on species associated with mature upland oak communities. The scarlet tanager is most abundant in mature, upland deciduous forests (Hamel 1992). It is most common in areas with a relatively closed canopy, a dense understory with a high diversity of shrubs, and limited ground cover (NatureServe 2015). Nearly 50% of the Cooper Creek area consists of mature upland hardwood forests. The scarlet tanager is a common breeding bird on the Blue Ridge Ranger District including the Cooper Creek watershed.

The scarlet tanager was selected as an MIS to help indicate the effects of management on species associated with mature upland oak communities. The scarlet tanager inhabits large blocks of mature forest, especially where oaks are common, but also may occur in young successional woodlands. Management emphasis for this species centers on maintaining large forest tracts and creating open canopies or canopy gaps.

Alternative 1: No Action

Direct and Indirect Effects – In the short-term, this alternative would perpetuate current conditions and no direct impacts to oak and oak-pine forest habitat are expected. The ongoing dormant season prescribed burns will not affect the availability of mature oak forests. Existing habitat conditions for the scarlet tanager and other species that utilize mature oak habitats would be maintained. Through time, the amount of mature oak forest habitat would increase as the portions containing young forests mature. This should result in improved habitat conditions for the scarlet tanager and other species that utilize these habitats.

Cumulative Effects - Mature oak forests are abundant on the Cooper Creek area and Forest as a whole. The USGS Breeding Bird Survey indicates a stable trend for this species in the Appalachian Mountains from 1966 - 2012 (Sauer et al., 2014). Similarly, analysis of breeding bird population trends on Southern National Forests (1992-2004), also indicates that scarlet tanager populations have been stable in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data from the Chattahoochee-Oconee National Forests suggests the scarlet tanager population remains stable on the Forest (USDA Forest Service 2012). However, with no-action, shade-tolerant white pine seedlings and mesophytic hardwoods may become established in some of the mature oak stands, reducing the oak component in the future. The no action alternative would not provide for sustainable, long-term, habitat for this species. Under this alternative, this species would eventually start to decline within the project area.

Alternative 2: Proposed Action

Direct and Indirect Effects - Many of the vegetation management treatments proposed in this alternative would enhance habitat conditions for the scarlet tanager and species associated with mature oak forests. The thinning of oak/ oak-pine stands will result in the development a relative dense understory, increasing their habitat suitability. Other treatments such as the pine/pine-oak thinning, canopy gap thinning, regeneration harvests, midstory and release treatments and prescribed burning will maintain and restore oak-pine forest by enhancing oak regeneration. Through time, the amount of mature oak forest habitat in the project area will increase. This should result in improved habitat conditions for the scarlet tanagers and other species that utilize mature oak and oak-pine forest habitats.

The proposed prescribed burning is not expected to negatively affect scarlet tanagers. Rush et al. (2012) found that densities of mature forest birds such as scarlet tanager, tufted titmouse, red-eyed vireo, black-throated green warbler, and black-and white warbler populations did not differ relative to either fire severity or time since fire. The effects of the proposed herbicide use on small insectivorous birds such as the scarlet tanager are disclosed above in the prairie warbler section.

Cumulative Effects - The availability of older oak stands and populations of scarlet tanagers and associated species are expected to increase through the implementation of the Forest Plan (USDA Forest Service 2004a). Although some mature oaks would be cut under this alternative, mature oak forests will remain abundant in the project area and will increase through time with the implementation of the proposed activities. Mature mast producing stands are abundant on the Cooper Creek area and Forest as a whole. Oak forests also are common on adjacent private lands. However some of these forests are currently being lost to residential development or other land uses. Additionally, on other private forests, the lack of active management (especially prescribed fire) is resulting in the loss of oak dominance (USDA Forest Service 2004a).

There are no additional activities planned for the Cooper Creek that would affect the availability of mature oak forests. Therefore no cumulative effects to mature upland oak habitat and associated species such as scarlet tanagers are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for scarlet tanager and other species associated with mature oak forests are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Hooded Warbler

The Forest Plan identified the hooded warbler as a MIS to help indicate the effects of management on species associated with mature mesic deciduous forests. Hooded warblers are found in mixed

hardwood forests of beech, maple, hickory and oaks with dense undergrowth (DeGraaf et al 1991). They nest in the understory of deciduous forests, and a dense shrub layer and scant ground cover are important (NatureServe 2015). Mature forests with a structurally diverse understory and midstory layers are favored. They typically inhabit mature forests containing canopy gaps (La Sorte et al 2007). The hooded warbler is a very common breeding bird on the Blue Ridge Ranger District including the Cooper Creel watershed.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct impacts to mature mesic deciduous forest habitat are expected. The ongoing dormant season prescribed burns will not affect the availability of mature mesic hardwood forests. Existing habitat conditions for the hooded warbler and other species that utilize mature mesic deciduous habitats would be maintained. Through time, the amount of mature mesic deciduous habitat would increase as the portions containing young forests mature. This should result in improved habitat conditions for the hooded warbler and other species that utilize mature mesic deciduous habitats.

Cumulative Effects - Mature mesic hardwood forests are common on the Cooper Creek project area as well as the Forest as a whole. The Forest Plan has an objective to increase the structural diversity in mature mesic deciduous forests quantity and quality of these forests and populations of hooded warblers and associated species are expected to increase through the implementation of the Plan (USDA Forest Service 2004a). The US Geological Survey (USGS) Breeding Bird Survey indicates an increasing trend for this species from 1966 to 2012 in the Appalachian Mountains (Sauer et al., 2014). However, analysis of breeding bird population trends on Southern National Forests (1992-2004), suggests that that hooded warblers have decreased on in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data from the Chattahoochee-Oconee National Forests indicate a stable to slightly increasing forest-wide population trend for this species (USDA Forest Service 2012). There are no additional activities planned for the Cooper Creek area that would affect the availability of mature mesic deciduous forests. Therefore no cumulative effects to mature mesic deciduous habitat and associated species such as hooded warblers are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects- Many of the vegetation management treatments proposed in this alternative would enhance habitat conditions for the hooded warbler and species associated with mature mesic hardwood forests. Both the canopy gap treatments and thinning of oak/ oak-pine stands will result in the development a relative dense understory, increasing their habitat suitability for hooded warblers and other shrub-nesting birds. Prescribed burning (both dormant and growing season) will occur throughout the project area, including the mesic deciduous hardwood stands. The proposed prescribed burning also could result some changes to mesic forest conditions. As discussed above, in a recent study on the Chattahoochee National, Rush et al. (2012) found that densities of several bird species were influenced by fire severity and time since burning. Densities of hooded warblers were higher in the low severity burns than moderate and high severity burns and unburned controls. The majority of the previous and planned prescribed burns are of low to moderate severity and due to the moist conditions of these sites and the expected firing patterns, there will be little impact to these mesic sites from prescribed burning. However, shrub cover may decrease in more xeric portions of the project area where fire severity is likely to be higher. The effects of the proposed herbicide use on small insectivorous birds such as the hooded warbler are disclosed above in the prairie warbler section.

Cumulative Effects- Mature mesic hardwood forests are abundant on the Forest including the Cooper Creek watershed. The revised Forest Plan has an objective to increase the structural diversity in mature mesic deciduous forests quantity and quality of these forests and populations of hooded warblers and associated species are expected to increase through the implementation of the Plan (USDA Forest Service 2004a). This alternative will have a positive effect on mesic hardwood forest by creating canopy gaps that will enhance structural diversity. Within 2 to 3 years of the overstory thinning, these stands will begin to develop a relatively dense understory that will persist until canopy closure (approximately 10-15 years). There are no additional activities planned for the Cooper Creek area that would affect the availability of mature mesic deciduous forests. Therefore no cumulative effects to mature mesic deciduous habitat and associated species such as hooded warblers are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for hooded warbler and other species associated with mature mesic hardwood forests are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Chestnut-sided Warblers

The chestnut-sided warbler was selected as a MIS to help indicate the effects of management on species associated with high-elevation early successional forests. Chestnut-sided warblers are found in second-growth forests, overgrown fields, woodland edges, and in open, park-like woods (Hamel 1992). They are most common in suitable habitat over 3500 feet elevation, but occur sparingly down to 2000 feet and below. They are associated with dense vegetation in the form of shrubs and small trees about 3 feet above the ground that provides nesting sites and foraging areas (DeGraaf et al. 1991). Chestnut-sided warblers can be found in early successional forest habitats at higher elevations throughout the Forest. However, these types of habitat are limited on the Forest and have decreased due to a reduction in active forest management. A small number of chestnut-sided warblers have been reported from Breeding Bird Surveys in the project area; however current chestnut-sided warbler populations in the project area likely are low. Chestnut-sided warblers breed in higher elevations in the south and are associated with early successional habitats (La Sorte et al. 2006). The chestnut-sided warbler is an uncommon breeding bird on the Blue Ridge Ranger District with limited records from the Cooper Creek Watershed.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct changes to the distribution of high elevation successional habitats are expected. In general, the ongoing dormant season prescribed burns are not expected to substantially increase the availability of high elevation early successional forests. Through time, the amount of high elevation early successional

habitat would decrease as these young forests mature. This should result in a reduction in the habitat availability for the chestnut-sided warbler and other species that utilize these habitats.

Cumulative Effects - The USGS Breeding Bird Survey indicates stable trend for this species from 1966 - 2012 in the Appalachian Mountains (Sauer et al., 2014). However analysis of breeding bird population trends on Southern National Forests (1992-2004), suggest chestnut-sided warbler populations have declined on in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data from the Chattahoochee-Oconee National Forests indicate that the chestnut-sided warblers population occurs in low, relatively stable numbers on the Blue Ridge and Chattooga River Ranger Districts (USDA Forest Service 2012). There are no additional activities planned for the Cooper Creek project area that would affect the availability of high elevation early successional forests. Therefore no cumulative effects to chestnut-sided warblers or their habitat are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects - The vegetation management treatments and prescribed fire treatments proposed in this alternative would enhance habitat conditions for the chestnut-sided warbler and species associated with high elevation early successional forest habitats. A substantial portion of the stands proposed for regeneration or woodland development are at or near 3000 feet in elevation. These treatments should result in the development of optimal high elevation early successional forest habitat conditions for species like chestnut-sided warblers. The prescribed fire proposed in this alternative, particularly where severity is higher, also will benefit the chestnut-sided warbler. In a study conducted on the Chattahoochee National Forest, Klaus et al. (2010) reported that chestnut-sided warblers and other early successional species responded positively to increased fire severity and the resulting early successional habitat. The effects of the proposed herbicide use on small insectivorous birds such as the chestnut-sided warbler are disclosed above in the prairie warbler section.

Cumulative Effects - The revised Forest Plan has an objective to create and maintain a high elevation early successional component on the Forest, and chestnut-sided warbler populations are expected to increase through the implementation of the Plan (USDA Forest Service 2004a). Currently, high-elevation early successional forest habitat used by the chestnut-sided warbler is limited on the Cooper Creek project area and the Forest as a whole. However, projects such as this and the recently competed Brawley Mountain project will enhance habitat conditions for this species. The majority of the private land adjacent to the project area is in the lower elevation valleys, limiting available habitat for chestnut-side warblers.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for chestnut-sided warbler and other species associated with high elevation early successional forests are expected to be similar to Alternative 2. The acres of prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. The acres of regeneration harvest also is the same as Alternative 2, but fewer of the acres of at higher elevations. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Pine Warbler

The Forest Plan identified the pine warbler as a MIS to help indicate the effects of management on species associated with yellow pine and pine-oak forests. The pine warbler uses mid to late successional pine forests throughout the year (Hamel 1992). It occurs in both open pine woodlands and dense pine plantations, but seldom uses hardwood stands. The highest numbers seem to occur where pure stands of pine are found. It is less abundant as the proportion of hardwood tree species increases (NatureServe 2015). The pine warbler is a relatively common breeding bird on the Blue Ridge Ranger District but rare in the Cooper Creek watershed due to the lack of mature yellow pine. There currently is less than 100 acres of mature yellow pine stands in the Cooper Creek project area.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct impacts to pine and pine-oak forest habitat are expected. The ongoing dormant season prescribed burns would have a limited effect the availability of yellow pine forests. Existing habitat conditions for the pine warblers and other species that utilize pine forests would be maintained. However, mature yellow pine is rare in Cooper Creek watershed. Through time, the limited number of existing young pine stand would mature, providing additional habitat for pine warblers and species that utilize mature pine forests. In addition, future attacks from southern pine beetle and encroachment from white pines and hardwoods would result in a reduced pine component in the future.

Cumulative Effects- Mature yellow pines are rare in Cooper Creek watershed and are likely to decline further under the no-action alternative. The USGS Breeding Bird Survey indicates stable trend for this species from 1966 - 2012 in the Appalachian Mountains (Sauer et al., 2014). Similarly, analysis of breeding bird population trends on Southern National Forests (1992-2004), also indicates that pine warbler populations have been stable in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data from the Chattahoochee-Oconee National Forests suggests the pine population remains stable on the Forest (USDA Forest Service 2012). There are no additional activities planned for the Cooper Creek area that would affect the availability of mature pine forests. Therefore no cumulative effects to pine and pine-oak forest habitat and associated species such as pine warblers are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects- Mature yellow pines are extremely limited in the Cooper Creek watershed as are species associated with mature yellow pine like the pine warbler. The proposed thinning and prescribed burning would provide favorable conditions for the establishment of yellow pine seedlings but given the limited quantity of mature shortleaf pine seed trees, this is expected to be minimal. The availability of habitat for species such as the pine warbler is not expected to increase substantially with this alternative. The effects of the proposed herbicide use on small insectivorous birds such as the pine warbler are disclosed above in the prairie warbler section.

Cumulative Effects - The availability of older pine stands and populations of pine warblers and associated species are expected to increase through the implementation of the revised Forest Plan

(USDA Forest Service 2004a)**.** Mature yellow pine forests common on the Forest as a whole but are very limited on the Cooper Creek area. While the availability of older pine stands on the Forest has increased over the last few decades, recent outbreaks of Southern Pine beetle have reduced the availability of these habitats on some portions of the Forest. Shortleaf pine stands will decline in the surrounding area because of the increase in urbanization and a lack of prescribed burning on private lands. Private ownership in the surrounding area is made up of individually owned small blocks that cannot be feasibly burned. Residential development in the urban interface will continue to remove portions of remaining shortleaf pine in the area. Southern Pine Beetle mortality on private lands has also reduced the shortleaf component in adjacent areas.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for pine warbler and other species associated with mature yellow pine forests are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action. As with Alternative 2, the availability of habitat for species such as the pine warbler is not expected to increase substantially with this alternative

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Acadian Flycatcher

The Forest Plan identified the Acadian flycatcher as the MIS to represent Mid-Late Successional Riparian Habitat Conditions. Habitat for the Acadian flycatcher consists of deciduous forests near streams (Hamel 1992). Preferred habitat for this species is moist bottomlands, swamps, and riparian thickets. Usually this bird builds its nest in branches directly overhanging streams. Mature riparian forests and a result, Acadian flycatchers are abundant throughout the Blue Ridge Ranger District including the Cooper Creek watershed.

Alternative 1: No Action

Direct and Indirect Effects – This alternative would perpetuate current conditions and no direct impacts to riparian habitat are expected. The ongoing dormant season prescribed burns would have no effect on riparian habitats. Through time, the amount of mid-to-late successional riparian habitat would increase as the portions containing young forests mature. This should result in improved habitat conditions for the Acadian flycatcher and other species that utilize mature riparian habitats.

Cumulative Effects - Mid-to-late successional forested riparian habitat is common on the Forest and the availability of these older riparian habitats and populations of Acadian flycatchers and associated species are expected to increase through time with the implementation of the Forest Plan (USDA Forest Service 2004a). Riparian Corridor standards would be followed on all projects on the Forest to maintain desirable habitat conditions in the riparian corridor. The US Geological Survey (USGS)

Breeding Bird Survey indicates a decreasing trend for this species from 1966 to 2012 in the Appalachian Mountains (Sauer et al., 2014). However, analysis of breeding bird population trends on Southern National Forests (1992-2004), suggest that Acadian flycatcher populations have been stable in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data from the Chattahoochee-Oconee National Forests indicate a stable forest-wide population trend for this species (USDA Forest Service 2012).There are no activities planned for the project area that would affect the availability of mature riparian forests. Therefore no cumulative effects to riparian habitat and associated species such as Acadian flycatchers are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects - The vegetation management treatments and prescribed fire treatments proposed in this alternative have the potential to impact riparian habitat conditions. However, application of riparian corridor standards (MRx 11) and Best Management Practices (BMPs) will ensure that desired conditions in the riparian corridor will be maintained and enhanced. These include provisions for controlling impacts from activities such as vegetation management, fireline construction, and trail construction. Major ground disturbing activities such as road construction (except at designated crossings) log landings and bladed firelines are prohibited in the riparian corridor. Within the riparian corridor, the degree of canopy opening will be limited and a continuous forest canopy will be maintained on these sites. Prescribed fire in the riparian zone will consist of low intensity, backing fires that will result in little change to the vegetation conditions in these areas. No herbicide application will occur within the riparian corridor. As a result of these measures, riparian habitat conditions and populations of associated species such as the Acadian flycatcher will be maintained. The effects of the proposed herbicide use on small insectivorous birds such as the Acadian flycatcher are disclosed above in the prairie warbler section.

Cumulative Effects - Mid-Late Successional forested riparian habitat is common on the Forest and the availability of these older riparian habitats and populations of Acadian flycatchers and associated species are expected to increase through time with the implementation of the revised Forest Plan (USDA Forest Service 2004a). Riparian Corridor standards will be followed on all projects on the Forest to maintain desirable habitat conditions in the riparian corridor. There are no activities planned for the Cooper Creek area that would affect the availability of mature riparian forests. Therefore no cumulative effects to riparian habitat and associated species such as Acadian flycatchers are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for the Acadian flycatcher and other species associated with mature riparian forests are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Field Sparrow

The Forest Plan identifies the field sparrow to help indicate the effects of management on species associated with woodland, savanna, and grassland communities. It is associated with scattered saplings or shrubs in tall weedy or herbaceous cover (Hamel 1992). Woodlands, grasslands, and savannahs were once a frequent occurrence across the southeastern landscape on xeric ridge-tops and south-facing slopes (USDA Forest Service 2004a). These fire-maintained communities were characterized by sparse tree cover and a well-developed, herbaceous understories. At the present time there are not any woodland or savanna forest communities in the project area. There are approximately 70 acres of grasslands that are maintained as permanent wildlife openings. These types of habitats are uncommon on the Blue Ridge Ranger District, including the Cooper Creek watershed. Field sparrows are relatively uncommon on the Blue Ridge Ranger District, including the Cooper Creek Watershed. Only 1 individual has been recorded over 24 years of surveys in the watershed.

Alternative 1: No Action

Direct and Indirect Effects – This alternative would perpetuate current conditions and habitat conditions for field sparrows and other species associated with woodland, savanna, and grassland. The ongoing dormant season prescribed burns would have a limited effect the availability of these habitats and they would remain extremely limited.

Cumulative Effects - There are some open grasslands in the surrounding area in the form of pastures. Some of these are being converted into residential areas further reducing grasslands in the area. Woodland, grassland, and savanna habitat is extremely limited in the Cooper Creek project area and the Forest as a whole. The US Geological Survey (USGS) Breeding Bird Survey indicates a decreasing trend for this species from 1966 to 2012 in the Appalachian Mountains (Sauer et al., 2014). Similarly, analysis of breeding bird population trends on Southern National Forests (1992-2004), suggests there has been population decreases in field sparrows in the Southern Blue Ridge (La Sorte et al 2007). Bird monitoring data on the Chattahoochee-Oconee National Forests indicate that field sparrow populations on the Forest are low with some increase in observations on the Chattooga River Ranger District (USDA Forest Service 2012). The overall amount of preferred habitat for field sparrow has declined and woodland and savanna creation has not occurred on the Forest at the level described in the Forest Plan.

Alternative 2: Proposed Action

Direct and Indirect Effects - The proposed woodland restoration and prescribed burning under this alternative will begin the development of some woodland conditions in the existing closed canopy stands. Approximately 764 acres will be thinned (commercial and non-commercial) to a residual basal area of 15-60 square feet per acre. The thinning and subsequent prescribed burning will help promote a more well developed herbaceous understory in these stands. This would result in enhanced habitat conditions for field sparrows and other species associated with woodland, savanna, and grassland habitats. The effects of the proposed herbicide use on small insectivorous birds such as the field sparrow are disclosed above in the prairie warbler section.

Cumulative Effects – There are some open grasslands in the surrounding area in the form of pastures. Some of these are being converted into residential areas further reducing grasslands in the area. Woodland, grassland, and savanna habitat is extremely limited on the Cooper Creek

project area and the Forest as a whole. However, projects such as this and the recently competed Brawley Mountain project will enhance habitat conditions for this species Across the Forest, the availability of these habitats is expected to increase with the implementation of the revised Forest Plan (USDA Forest Service 2004a). The revised plan has an objective of restoring 10,000 acres of open woodlands, savannahs, and grasslands on the Chattahoochee within the first 10 years of plan implementation (Objective 3.4). This would result in enhanced habitat conditions for field sparrows and other species associated with woodland, savanna, and grassland habitats.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for the field sparrow and other species associated with woodland, savanna, and grassland communities are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

Black Bear

The black bear was selected as a MIS to help indicate the effects of management in meeting public demand as a hunted species. In the Southern Appalachians, important habitat elements for black bears are habitat diversity, den site availability, availability of hard mast, and habitat remoteness (USDA Forest Service 2004a).

Black bear populations in the Southern Appalachians have been steadily increasing for the past 25 years and are currently described as "stable to slightly increasing" for the tri-states area of North Georgia, Western North Carolina and Upstate South Carolina. Based on harvest records and bear and human encounters, state biologists have concluded that bears are nearing carrying capacity on the Chattahoochee NF. Hunter harvest data is typically a good measure of population size. The Cooper Creek WMA has a relatively high bear population, with an average annual harvest of 5 bears (Table 3.14.1).

Table 3.14.1. Black Bear Harvest for Cooper Creek WMA 1979-2014.

Year	Harvest	Year	Harvest	Year	Harvest
1979	3	1991	0	2003	5
1980	6	1992	1	2004	8
1981	0	1993	5	2005	1
1982	0	1994	3	2006	9
1983	0	1995	8	2007	9
1984	2	1996	2	2008	4
1985	4	1997	3	2009	9
1986	1	1998	4	2010	9
1987	5	1999	3	2011	3

1988	9	2000	5	2012	10
1989	1	2001	12	2013	13
1990	4	2002	4	2014	1
				Average	4.6

Mature hard mast producing stands that are important to bears are common on the Forest including the Cooper Creek watershed. However, early successional forest that are important sources of soft mast are much more limited across the Forest.

Alternative 1: No Action

Direct and Indirect Effects This alternative would perpetuate current conditions and no direct impacts to black bear are expected. Through time, the amount of mature upland hardwood forests would increase as the Forest matures resulting in increases in hard mast and den tree availability. The ongoing prescribed burning will continue to enhance soft mast production in some of the more open stands. However, the limited amount of available early successional forest habitat in the project area would decline as the forests in the area mature. This should result in a further reduction of the availability of soft mast important to bears and many other species.

Cumulative Effects - Increased acres of older hardwood stands, sustained hard mast production, and enhanced soft mast production through forest management activities—such as prescribed burning and timber harvest—have contributed to improved black bear habitat on the Forest. Mature hard mast producing stands that are important to bears are common on the Cooper Creek watershed as well as the Forest as a whole. However, early successional forest that are important sources of soft mast are much more limited across the Forest. Implementation of the revised Forest Plan is expected to provide a diversity of habitats that will benefit black bear populations on the Forest (USDA Forest Service 2004a). No additional activities affecting bear habitats are planned the project area. Therefore no cumulative effects to black bear or their habitat are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects –The vegetation management, prescribed burning and road management activities proposed in this alternative would likely increase the black bear population within the project area by: 1) increasing the amount of hard mast (oak) regeneration within the project area, 2) increasing the amount of soft mast producing species, particularly through prescribed fire and woodland restoration, and 3) increasing habitat remoteness by restricting vehicular access along several roads which are currently open to vehicles during the hunting season.

The canopy openings resulting from the proposed thinning, regeneration, woodland, and canopy gap activities will increase the production of soft mast and herbaceous forages in these stands. Similarly, prescribed burning also will stimulate the production of new growth of both herbaceous and woody species.

Some mature mast producing oaks will be cut through the proposed regeneration and thinning treatments. Approximately 200 acres of mature hardwood stands will be regenerated in this alternative, which represents a small fraction of the mature hardwood forest in the project area. Mature oak stands comprise nearly 50 percent of the analysis area and the availability of oak mast will remain high. In the

thinning treatments, the expansion of the crowns of the remaining trees will largely offset any reduction in oak mast production, especially on the lower slopes. Crown size has a strong influence on oak mast production (Greenberg 2000). Through time, the amount of mid-late successional oak forests will increase as the forests in the area mature. This should result in increased hard mast production in the area, which will benefit bear and other mast-dependent species. The planting of oak seedlings in several regeneration stands as well as the proposed midstory and release treatments also will enhance future hard mast capability. The use of herbicides to release the planted oak seedlings will help ensure successful establishment.

Existing den sites and potential black bear den trees in the project area will be protected (Forest-wide standards FW-009, FW-010). Approximately 60% the analysis area is over 80 years of age, and therefore potential den trees will remain relatively common across the area.

Details of the herbicide risk assessment are summarized in Appendix F. Hazard quotients for non-accidental acute and chronic exposures for large mammals consuming contaminated fruit and/or vegetation have typical values over 1.0. Typical HQ values for non-accidental acute exposure from consumption of contaminated vegetation by large mammals and small birds are over 1.0 (4.0 and 5.0, respectively). Typical HQ values for chronic exposures resulting from consumption of contaminated fruit by large mammals and small birds, and from consuming contaminated vegetation by small, larger, and large mammals and small birds are over 1.0 as well (sheet G02a).

However these scenarios are unlikely and the risks of such contamination are reduced due to the following:

• With cut-stump applications, trees are severed from their stumps and the herbicide is applied to the cut-stump surface and therefore there is no risk of contaminated fruit or vegetation.
• With stem injections treatments, vegetation to be treated is typically above forage/browse levels for mammals and therefore there is little risk of consumption of contaminated vegetation.
• Cut surface treatments (cut stump and stem injections) are very targeted and precise and apply very small amounts of diluted herbicide. The amount of non-target vegetation subject to spray deposition consequently is very small and unlikely to affect foraging/browsing mammals or birds.
• Foliar treatments would be applied with backpack sprayers and applied to target stump sprouts; contamination to non-target vegetation most likely to be consumed would be minimal.
• The period in which treated vegetation (stumps sprouts and adjacent non-target vegetation) remains edible/available following treatment would be very short and would limit exposure time.
• Stump sprouting vegetation is targeted for treatment under foliar applications. This vegetation would not produce fruit to be consumed by wildlife species.
• These scenarios assume a diet composed of 100 percent contaminated fruit or vegetation from the site. The diets of large mammals and birds are highly variable and include other food sources. For chronic exposures, scenarios assume that contaminated fruit or vegetation will be consumed for 90 consecutive days. These assumptions make scenarios highly unlikely especially in context of the other reasons stated above.
• Also, these scenarios are based on individuals, and although an individual may be affected, there would not be significant effects to a population.

Cumulative Effects - Increased acres of older hardwood stands, sustained hard mast production, and enhanced soft mast production through forest management activities—such as prescribed burning and timber harvest—have contributed to improved black bear habitat on the Forest. Implementation of the revised Forest Plan is expected to provide a diversity of habitats that will benefit black bear populations on the Forest (USDA Forest Service 2004a).

Mature hard mast producing stands that are important to bears are common on the Cooper Creek watershed as well as the Forest as a whole. Although some mature oak stands will be regenerated in this alternative, the availability of oak mast will remain high. Mature mast producing stands comprise nearly half of the analysis area. There are nearly 200,000 acres of mast producing stands on the Blue Ridge Ranger District (64% of the forested acres) and over 400,000 acres on the Chattahoochee National Forest (56% of forested acres). Early successional forest that are important sources of soft mast are much more limited across the Forest. This project and other ongoing and future projects are expected to increase the availability of early successional habitats. No additional activities affecting bear habitats are planned the project area. Therefore no cumulative effects to black bear or their habitat are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for black bears are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

White-tailed Deer

White-tailed deer was selected as a MIS to help indicate the effects of management in meeting public demand as a hunted species. Deer require a mixture of forest/successional stage habitats to meet their year-round habitat needs. Key requirements include the interspersion of mature mast producing stands during fall and winter, early successional forest to provide browse and soft mast, and high quality permanent openings.

Deer harvest data collected by Georgia DNR indicates that deer populations in the Blue Ridge and Piedmont portions of the forest are gradually decreasing, most likely due to the older age class of the forest and related lack of early-successional habitat. Although mature mast producing stands and high quality permanent openings are abundant, current deer populations in the Cooper Creek WMA are moderate on due to limited availability of early successional habitat. The Georgia DNR collects deer harvest data during the managed deer hunts on Cooper Creek Wildlife Management Area. Hunter harvest data is typically a good measure of population size. Table 3.14.2 shows 40 years of deer hunter harvest data collected by Georgia DNR within the Cooper Creek WMA. Deer harvest and hunter success peaked in the late 1990's to the early 2000's and has steadily decreased since then (Figure

3.14.1). This decrease is attributed to the decline of timber harvesting within the WMA since the mid 90's, and resulting decline in early- successional habitat.

As discussed in Section 3.8 above, less than 0.5% of the Cooper Creek project area currently consists of early-successional habitat (142 acres). Conversely, in the early "90's", when deer hunter harvest was at its peak, Forest Service vegetation data shows that over 6% of the project area consisted of early-successional forest (vegetation less than 10 years old). This difference between historic early-successional habitat conditions and current early successional habitat conditions directly coincides with the drastic drop in hunter success over the last 10-15 years.

Table 3.14.2 Number of Hunters, Deer Harvest, Hunter Success for the Cooper Creek WMA 1975-2014

Year	# Hunters	Harvest	Success	Year	# Hunters	Harvest	Success
1975	1194	76	6.4	1995	1572	154	9.8
1976	783	32	4.1	1996	1710	134	7.8
1977	739	25	3.4	1997	1236	73	5.9
1978	374	10	2.7	1998	1526	203	13.3
1979	983	59	6.0	1999	1714	256	14.9
1980	1246	80	6.4	2000	1731	130	7.5
1981	1277	140	11.0	2001	1676	209	12.5
1982	1962	116	5.9	2002	1585	183	11.5
1983	1979	171	8.6	2003	1902	148	7.8
1984	1776	104	5.9	2004	1652	117	7.1
1985	1663	81	4.9	2005	1004	113	11.3
1986	1651	115	7.0	2006	1338	89	6.7
1987	1811	134	7.4	2007	1392	127	9.1
1988	2208	186	8.4	2008	1594	111	7.0
1989	2364	116	4.9	2009	1489	115	7.7
1990	1824	170	9.3	2010	1502	123	8.2
1991	1735	147	8.5	2011	1303	65	5.0
1992	1667	108	6.5	2012	1401	104	7.4
1993	1042	52	5.0	2013	1296	70	5.4
1994	1520	115	7.6	2014	1206	63	5.2
				Average	**1476**	**115**	**7.5**

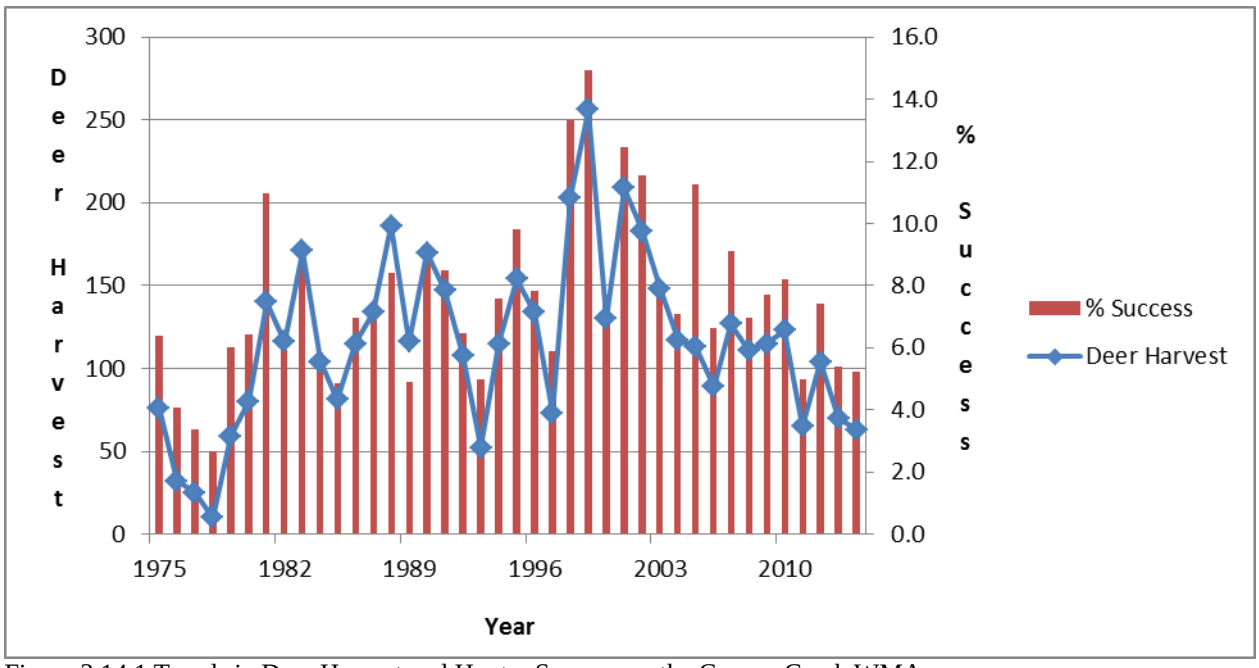

Figure 3.14.1 Trends in Deer Harvest and Hunter Success on the Cooper Creek WMA.

Alternative 1: No Action

Direct and Indirect Effects - This alternative would perpetuate current conditions and no direct impacts to white-tailed deer are expected. The ongoing prescribed burning will continue to enhance soft mast production in some of the more open stands. However, through time, the limited amount of available early successional habitat in the project area would decline as the forests in the area mature. This should result in a reduction of the availability of deer forages and habitat conditions for deer.

Cumulative Effects - Although mature mast producing stands and high quality permanent openings are abundant in the Cooper Creek Watershed, early successional forest habitat is limited. Implementation of the Forest Plan is expected to provide a diversity of habitats that would benefit white-tailed deer populations on the Forest (USDA Forest Service 2004a). However, no additional activities affecting deer habitat are planned for the project area. Therefore no cumulative effects to white-tailed deer or their habitat are expected.

Alternative 2: Proposed Action

Direct and Indirect Effects - The treatments proposed under this alternative will result in improved habitat conditions for deer. The canopy openings resulting from the proposed thinning, regeneration, woodland, and canopy gap activities will increase the production of soft mast and herbaceous forages in these stands. Similarly, prescribed burning also will stimulate the production of new growth of both herbaceous and woody species will increase the production of browse and soft mast.

Although some mature mast producing oaks will be cut through the proposed regeneration and thinning treatments the availability of oak mast in the project area will remain high. The proposed thinning, prescribed burning and herbicide treatments, as well as the planting of oaks in a portion of the regeneration areas will result in an increased oak component in future stands. In addition, through time, the amount of mid-late successional oak forests will increase as the forests in the area mature. This

should result in increased hard mast production in the area, which will benefit deer and other mast-dependent species. The effects of the proposed herbicide use on large mammals such as white-tailed deer are disclosed above in the black bear section above.

Cumulative Effects - Across the Forest, implementation of the revised Forest Plan is expected to provide a diversity of habitats that will benefit white-tailed deer populations on the Forest (USDA Forest Service 2004a). The vegetation management and prescribed burning in this alternative will enhance deer habitat on the Cooper Creek project area. No additional activities affecting deer habitat are planned for the Cooper Creek area. Therefore no cumulative effects to white-tailed deer or their habitat are expected.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on habitat for white-tailed deer are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

3.15 Non-native Invasive Plant Species

3.15.1 Affected Environment

Existing Conditions:

Site-specific inventories for Non-Native Invasive plant Species (NNIS) occurred during the 2014 and 2015 field seasons (May-August). Access roads and adjacent stands also were surveyed. Detailed records for these surveys are found in the TESP/Invasive Species database. The High Priority NNIS infestations in the project area are shown in Table 3.15.1 below. NNIS were found along all routes but the density and species composition varied by road and level of past disturbance. This survey and other surveys in the area indicate that NNIS infestations are usually restricted to roadsides, disturbances, wildlife openings, and drainages.

Nepalese browntop and sericea lespedeza occur along all access roads. Sericea lespedeza was likely planted in most of the locations. Nepalese browntop has invaded the area along road corridors. Both species appear limited to disturbed areas such as the roadside, wildlife openings, and campsites. Tall fescue was also planted and occurs in openings and along some roads.

Table 3.15.1: High priority NNIS Infestations in the Cooper Creek Watershed project

Scientific Name	Common Name	I-Rank
Celastrus orbiculatus	Oriental bittersweet	H
Cirsium vulgare	Bull thistle	M

Daucus carota	Queen Anne's lace	L
Dioscorea oppositifolia	Chinese yam	Unranked
Elaeagnus umbellata	Autumn olive	H
Kummerowia stipulacea	Japanese clover	L
Lespedeza bicolor	Shrub lespedeza	M
Lespedeza cuneata	Sericea lespedeza	M
Leucanthemum vulgare	Oxeye daisy	M
Ligustrum sinense	Chinese privet	H
Lonicera japonica	Japanese honeysuckle	H
Microstegium vimineum	Nepalese browntop	H
Polygonum cespitosum	Oriental lady's thumb	Unranked
Rosa multiflora	Multiflora rose	M
Rubus phoenicolasius	Wineberry	M
Schedonorus arundinaceus	Tall Fescue	H
Spiraea japonica	Japanese meadowsweet	H

Invasive Species Impact Ranks (I-rank) were determined from NatureServe.

The Blue Ridge Ranger District's program currently controls for non-native invasive plant species under a previous decision (USDA Forest Service 2009). Since 2009, the District has been activity controlling NNIS through the use of herbicides as well as with mechanical methods.

3.15.2 Effects on Non-native Invasive Plant Species

Measure: Risk of invasion and spread of Non-Native Invasive plant Species from project activities. ***Bounds of Analysis*****: – Spatial:** the Cooper Creek Watershed Analysis Area includes is approximately 34,000 acres National Forest and adjacent private lands. **Temporal:** Approximately 10 years following implementation.

Alternative 1: No Action

Direct and Indirect Effects - The No Action does not propose any new ground disturbing activities or canopy treatments that would increase suitable habitat for non-native invasive plants. Current trends for new infestations and expansion and current levels of treatment would likely continue. The ongoing prescribed burning could have both positive and negative consequences in terms of the spread of invasive plants. Existing control lines will be used so there will be no new ground disturbance associated with the prescribed burning. Some of these species can be promoted by fire and on some sites, can spread displacing native vegetation and altering species diversity and wildlife suitability (Evans et al, 2006). Many of the invasive plants that are found in the analysis area recolonize or resprout after fire. Although burning does not eradicate honeysuckle, several studies have demonstrated that prescribed burning inhibits spread by killing seedling and young plants (Nuzzo 1997). Land managers in Alabama have controlled privet by means of burning when done annually under particular environmental conditions (Batcher 2000). Timing of the prescribe burn also affects the response of non-native invasive plants. For example, spring burns may encourage germination of lespedeza, late season burns may kill seedlings as well as destroy any seeds (Stevens 2002). However,

prescribed fire along can increase the cover of native grasses and forbs which can prevent the introduction and spread of invasive plants.

Cumulative Effects - The No Action would create no new suitable habitat for invasive species in the project area. Ongoing projects associated with other decisions such as road maintenance, wildlife opening maintenance, trail maintenance, prescribed burning, and non-native invasive plant detection and control would continue to take place. There would be no additional cumulative effects of Alternative 1 associated with this project.

Alternative 2: Proposed Action

Direct and Indirect Effects - Many activities associated with the proposed action would have direct and indirect effects on non-native invasive plants. The activities in this alternative could increase the density of existing infestation and spread of species into new areas. Areas with ground disturbance such as temporary roads (construction, reconstruction, and closing), log landings, and road maintenance are at a higher risk of invasion and spread of non-native invasive plants.

Opening the canopy and increasing disturbance is likely to increase Nepalese browntop, sericea lespedeza, Japanese honeysuckle, multiflora rose, shrub lespedeza, autumn olive, Chinese privet, and oriental bittersweet especially when the infestation is in or adjacent to the stand. However, opening the canopy will also increase native species in the understory to compete with NNIS. Using open areas with infestations as log landings will increase the spread of the species including Nepalese browntop (Shelton 2011). In many cases, the locations of the temporary roads, skid trails, and log landings would be the same locations as from past harvesting operations which are also more likely to have non-native invasive plant species present, increasing the risk of spread into new areas. Where possible, skidding through known populations of NNIS should be avoided to reduce the potential for spread.

Design criteria for minimizing soil erosion will reduce the risk from non-native invasive plants. Disturbed soils will be sown with native plant seed or non-persistent, non-native seed (FW Standard FW-056). Successful establishment of vegetation should reduce microsites for non-native invasive plant establishment. Mulch may also prevent establishment of non-native invasive plants. Where available, the use of weed-free mulch or hay from native perennial grass species will reduce the likelihood of inadvertent introduction of NNIS.

Equipment can be a source of new introductions as well as a vector for the spread of existing populations. To reduce the introduction and spread of non-native invasive plants, contract clauses require operators to clean equipment before entering any work site and when moving to a new site. Equipment cleaning contract provisions directs the Forest Service to identify areas with invasive species of concern on the Sale Area Map. In addition, it provides specific requirements for cleaning equipment when moving from areas infested with invasive species of concern to uninfested areas as well as direction regarding equipment inspection. These provisions should help minimize the spread of NNIS.

Riparian areas seem to present increased risk for invasion, since these areas are more productive, and appear to provide the best growing conditions for some species, particularly for Nepalese browntop, Japanese honeysuckle and privet. However, the majority of the ground disturbance activities would occur on upland sites and disturbance in the riparian area of the project area would be limited.

Skidding in riparian corridors is prohibited except for at designated crossings, which will minimize the potential for spread.

The ongoing control program on the District would help reduce the potential of spread of NNIS in the project area. Additional NNIS populations located during the inventories of the project area would be targeted for control as funding and resources allow.

Cumulative Effects – The Proposed Action would increase the risk of introduction, establishment and spread of non-native invasive species compared to the No Action Alternative by increasing the amount of ground disturbance in the project area. This Alternative would increase ground disturbance along roadsides which are the primary habitat for introduction and spread of non-native invasive plants. If infestations of non-native invasive plants were established, the site would serve as an additional source for new infestations and spread into adjacent areas. Eventually, these sites could expand into undisturbed habitats. The amount of risk would depend on existing conditions (species present), the distance to existing sites, and intensity of the disturbance. Road corridors, trails and other vectors for spread (off-road vehicles, recreational use, and road maintenance) would continue. On-going road maintenance would provide areas suitable for new infestations. Adjacent private property may serve as continued sources of non-native invasive plants.

Several measures are in place in this and other projects on the Forest to reduce the effects of NNIS. Erosion control practices to quickly establish vegetative cover would minimize the risk from non-native invasive plants in the areas of ground disturbance. In addition, as discussed above, the spread of NNIS would be reduced through the Equipment Cleaning provision in timber sale contracts. Ongoing NNIS control efforts also would continue across the District, targeting NNIS populations with the greatest threat to native plant communities. The use of these measures should help minimize the cumulative effects of NNIS on this and all other vegetation management projects on the Forest.

Alternative 3

Direct and Indirect Effects - The effects of this alternative on the spread of NNIS are expected to be similar to Alternative 2. The acres of regeneration harvest and prescribed burning are the same as Alternative 2 while the acreage of commercial, non-commercial treatments and herbicide use is less. Although this alternative differs slightly from the proposed action in the noncommercial and commercial treatments, these differences are not thought to be significant enough to provide a difference in the direct and indirect effects already disclosed above under the Proposed Action.

Cumulative Effects - Although this alternative differs slightly from the proposed action, these differences are not thought to be significant enough to provide a difference in the cumulative effects already disclosed above under the Proposed Action.

3.16 Recreation and Scenery

3.16.1 Affected Environment

The landscape character goal envisioned for management prescriptions 7.E.1 Dispersed Recreation Management Prescription, 7.E.2 Dispersed Recreation Areas with Vegetation Management, and 9.H Management, Maintenance, and Restoration of Plant Associations to Their Ecological Potential is *natural appearing.* The management emphasis for 7.E.1 and 7.E.2 is to improve the settings for non-

formal outdoor recreation in a manner that protects and restores the health, diversity and productivity of the watersheds. Such areas would be managed and monitored to absorb moderate to high levels of use. The management emphasis for 9.H is the restoration of historical plant associations and their ecological dynamics to ecologically appropriate locations. The predominant landscape for all three management prescriptions is natural appearing with variations of structurally diverse mid- to late- successional communities and some level of early successional forest.

OBJ-7.E.1-01 states as the sole objective for Dispersed Recreation Areas to:

> *Manage forest successional stages to maintain a minimum of 75 percent of forested acres in mid- and late-successional forest, including old growth; a minimum of 50 percent of forest acres in late successional forest, including old growth, and up to 4 percent per decade in early-successional forest.*

OBJ-7.E.2-01 states as the sole objective for Dispersed Recreation Areas with Vegetation Management to:

> *Manage forest successional states to maintain a minimum of 50 percent of forested acres in mid- to late-successional forest, including old growth; a minimum of 20 percent of forested acres in late-successional forest, including old growth, and 4 to 10 percent per decade in early-successional forest.*

OBJ-9.H-01 states as the sole objective for Management, Maintenance, and Restoration of Plant Associations to Their Ecological Potential to:

> *Manage forest successional states to maintain a minimum of 50 percent of forested acres in mid- to late-successional forest, including old growth; a minimum of 20 percent of forested acres in late-successional forest, including old growth, and 4 to 10 percent per decade in early-successional forest.*

A visually-appealing landscape is achieved by providing vista openings, featuring special attractions like rock outcroppings and waterfalls, and by providing park like stands and a diversity of vegetation species and age classes.

Tables 3.16.1-3.16-3 display the Scenery standards relating to management activities in the pertinent Rx Areas as required by the Forest Plan (FLRMP).

Table 3.16.1. Scenery Standard 7.E.1-006 in the Forest Plan

Inventoried Scenic Class	1	2	3	4	5	6	7
Scenic Integrity Objectives	H	M	M	M	M	M	M

Table 3.16.2. Scenery Standard 7.E.2-006 in the Forest Plan

Inventoried Scenic Class	1	2	3	4	5	6	7
Scenic Integrity Objectives	H	M	M	L	L	L	L

Table 3.16.3. Scenery Standard 9.H.2-013 in the Forest Plan

Inventoried Scenic Class	1	2	3	4	5	6	7
Scenic Integrity Objectives	H	M	L	L	L	L	L

The majority of vegetation management treatments would occur within areas classified as having a Moderate Scenic Integrity Objective while some treatments would occur within areas classified as having a High Scenic Integrity Objective (along Duncan Ridge and Mulky Gap Road).

The following is a list of affected travel ways and areas:

- Duncan Ridge Road
- Mt. Pleasant Church Road
- Owltown Road
- Mulky Gap Road
- Addie Gap Road
- Bryant Creek Road
- Duncan Ridge Trail
- Cooper Creek Trail System
- Appalachian National Scenic Trail

3.16.2 Effects on Recreation and Scenery

Measure: This section discloses the effects of proposed project activities on the Landscape Character and the Scenic Integrity Objective (SIO) as determined in the Forest Plan using the Scenery Management System (SMS). The SMS uses scenic classes based on the relative value and importance of the landscape to the viewing public on a scale of one through seven. Scenic classes were derived by combining the scenic attractiveness of the area (which includes landscape character and existing scenic integrity) with landscape visibility (which includes concern levels, distance zones, and travel way importance). The Scenery Treatment Guide for Southern Region National Forests provides guidance for mitigation techniques to use in implementation of vegetative treatments (USDA Forest Service 2008).

***Bounds of Analysis*:**

Spatial: The geographic bounds for this analysis will include effects of actions on the scenic quality from typical observer positions, including primary travel ways and any significant use areas within or nearby the project area.

Temporal: The temporal bounds for this analysis consider the short-term and immediate impacts which result from active vegetation management activities (such as felling , skidding and hauling), up to 10 years in the future, since most vegetation manipulation that causes visual contrasts in this area is largely subordinate to the viewer after this time period.

Alternative 1: No Action

Direct and Indirect Effects

If no action is taken, immediate conditions would not change and scenery changes would be gradual. Dormant season prescribed burning will continue on a periodic basis with minimal effect on scenery other than improved park-like conditions and increased herbaceous groundcover over time.

Cumulative Effects

In combination with other ongoing and proposed management activities, scenic integrity would not change drastically. However, other planned recreation management activities such as relocation of portions of the Duncan Ridge Trail could impact scenic quality. Hemlock mortality due to the Hemlock Woolly Adelgid would continue over time leading to negative impacts to dispersed recreation and scenic quality.

Alternative 2: Proposed Action

Direct and Indirect Effects

The vegetation management treatments, regardless of type, would have a minimal to moderate and short term effect on recreational users. Access via authorized routes may be impacted by temporary road and trail closures that will only be utilized when necessary for public health and safety. Felling operations within 200 feet of the Duncan Ridge Trail, Duncan Ridge Road and Mulky Gap Road would be limited to weekdays to reduce conflicts with recreational users. Hauling operations would be limited to weekdays only as well. Existing unauthorized motorized routes that provide access to dispersed recreation areas would be closed permanently following project completion. Prescribed burning activities would temporarily close areas during fire activity, but impacts would be short term (24 to 48 hours). Smoke concerns would be mitigated by burning in appropriate weather conditions. Herbicide application would have low risk to the recreating public as disclosed in the Herbicide Risk Assessment (Appendix F).

Vegetation management activities are adjacent to several access roads. Reducing stand densities and creating haul and skid routes adjacent to these roads would increase the potential for the creation of illegal motorized routes. This potential would be mitigated by permanent closure of these routes, utilizing practices including slash scattering, earthern berms, and signage upon project completion. Eliminating unauthorized motorized access to dispersed recreation areas would facilitate more appropriate non-motorized access including hiking and walk-in camping. Vegetation management activities will not utilize existing trails as access routes, with the exception of a portion of the Shope Gap Trail. The trail would be restored to the original trail width and character upon project completion. Character trees/blaze trees that define the trail corridor would not be cut unless to mitigate safety concerns.

Proposed year-round and seasonal road closures would have minimal impact on recreational users. The two year-round road closures, Duncan Ridge Branch (FDR 39B) and Mark Helton Branch (FDR 33B), are dead-end roads with minimal vehicular use that would continue to provide walk-in access upon closure. The seasonal road closures only impact vehicular use from January through mid-March when recreational use is at a minimum.

Project activities are proposed to occur within areas of Moderate to High Scenic Integrity Objectives (SIO). Implementation of mitigation measures can be employed to maintain Scenic Integrity Objectives. Based on Geographic Information Systems (GIS) mapping and field observations, the proposed vegetation treatments would be considered as background of the Appalachian Trail viewshed (i.e. sight distance greater than 4 miles). Observer viewpoints from the Appalachian Trail are limited due to canopy cover with no open vistas.

It is critical to note that certain stands are visible from observer locations along the Duncan Ridge Trail, Mulky Gap Road (FDR 4) and Duncan Ridge Road (FDR 39) for varying distances up to 2 miles. Any modifications to the landscape will affect the visual quality along such travel ways. This is of particular significance for immediate foreground areas along the Duncan Ridge Trail, Mulky Gap Road (FDR 4) and Duncan Ridge Road (FDR 39), which are classified as primary travel ways. For primary travel ways with a High Scenic Integrity Objective, the potential to create noticeable deviations from the existing landscape character is unavoidable, and therefore certain mitigation measures must be implemented to protect the scenic attractiveness along these corridors. Appendix J displays the scenic integrity mitigations that would occur by treatment type and scenic integrity objective (SIO).

Restoration of woodland habitat is proposed to occur across approximately 764 acres of the project area. Restoration efforts would be conducted primarily on south facing slopes and xeric sites. Tree canopy reduction would be variable depending on aspect, slope and landform. Users would notice a more open forest canopy, with increased sunlight, and increased visual penetration into the understory. Tree canopy reduction will be variable with the expected residual basal area ranging from 15 to 30 square feet per acre on the most xeric sites and 60 to 80 square feet per acre on the most mesic woodland sites.

Thinning of oak/oak-pine stands and pine/pine-oak stands are proposed across approximately 955 acres of the project area. Canopy gap thinning proposed across 466 acres of the project area will be conducted in mesic hardwood stands to enhance habitat for a variety of bird species, which will improve wildlife viewing. The greatest canopy reductions occur in the 253 acres of proposed early successional forest habitat creation utilizing a two-aged with reserves harvest method with a proposed residual basal area of 20 square feet per acre.

As identified in Appendix J for the woodland and thinning operations (whether commercial or non-commercial) within 100 feet of Duncan Ridge Trail, Mulky Gap Road and Duncan Ridge Road, slash would be treated to an average height of 2 feet above the ground. In addition, leave tree and unit boundaries would be marked so as not to be visible within 100 feet of the Duncan Ridge Trail, Duncan Ridge Road and Mulky Gap Road. A transitional or feathered edge of 50 feet would also be implemented along the boundary of all vegetation management units adjacent to Duncan Ridge Trail, Duncan Ridge Road, or Mulky Gap Road.

In the case of early successional forest habitat creation, visual impacts will be mitigated by not conducting this treatment within 100 feet of Duncan Ridge Trail, Duncan Ridge Road or Mulky Gap Road and by establishing a 50 foot transitional or feathered edge around all these treatment areas. Temporary road and/or skid trail crossings across designated forest trails would be kept to a minimum. Trail segments used as crossings and areas utilized for skid trails/haul roads would be returned to their original condition upon project completion.

Prescribed burning and herbicide treatment would result minor to moderate visual effects. Initially, scorched or black earth and/or dead and browned vegetation would be perceptible. However, such effects would be short term (12 months or less).

Cumulative Effects

In combination with other ongoing and proposed management activities, the proposed action (given that scenic mitigation measures would be utilized) would have minor to moderate cumulative effects on visual quality. Over the next ten years, relocation of unsustainable sections of the Duncan Ridge Trail may occur which could impact observer viewpoints but the specific re-routes are unknown at this point in time and therefore cannot be evaluated. Hemlock mortality due to the Hemlock Woolly Adelgid would continue over time leading to negative impacts to dispersed recreation and scenic quality.

Alternative 3

Direct and Indirect Effects

The direct and indirect effects of this alternative on recreation and scenery in general are expected to be similar to Alternative 2. However, an overall reduction in acreage from 3,754 to 2,571 total treated acres will result in less effect on both recreation and scenery. In addition, changing the locations of the regeneration treatments and adjusting the treatment type from commercial to non-commercial in other proposed vegetation treatments would result in less overall effects on recreation and especially scenery.

Restoration of woodland habitat is proposed to occur across approximately 720 acres of the project area. This is only a minor reduction from the 764 acres proposed under alternative 2 and there were no adjustments to the locations of those stands that were originally proposed. Approximately 108 acres of woodland habitat within the High SIO area were shifted from commercial to non-commercial treatment. Otherwise, the direct and indirect effects are expected to be the similar to those described in Alternative 2.

The acreage of thinning of oak/oak-pine stands and pine/pine-oak stands is reduced by 114 acres from Alternative 2 and would comprise 841 acres. Canopy gap thinning proposed across 204 acres of the project area would be conducted in mesic hardwood stands to enhance habitat for a variety of bird species, which would improve wildlife viewing. This is a 266 acre reduction from what was proposed in Alternative 2. Under Alternative 3, there are no commercial canopy gap thinning treatments planned within High SIO areas which would result in less impact on both recreation and scenery, especially along Duncan Ridge Trail, Duncan Ridge Road, and Mulky Gap Road.

The greatest canopy reductions occur in the 249 acres of proposed early successional forest habitat creation utilizing a two-aged with reserves harvest method with a proposed residual basal area of 20 square feet per acre. Although the acreage is similar to the amount proposed under Alternative 2 for this type of treatment, the location of these treatments have been adjusted so that all have been removed from High SIO areas with the exception of compartment 504, stand 15. The acreage in this stand has been reduced from 42 to 25 acres to allow for an increased visual buffer along Duncan Ridge Road, which would mitigate scenic effects and minimize the potential for the area to incur illegal motorized use.

Midstory treatments represent the largest change in acres treated between Alternatives 2 and 3 with a 698 acre reduction in Alternative 3. The majority of this reduction would occur on the north side of Duncan Ridge and would further reduce the amount of treatments occurring in the High SIO. Although midstory treatments are non-commercial in nature and do not typically effect the overstory, this reduction in acres treated would further minimize the effects to recreation and scenery.

Under Alternative 3, the standards identified in the Scenery Treatment Guide for Southern Region National Forests will be used for mitigating impacts to scenery in implementation of vegetative treatments where they are deemed appropriate and applicable.

Proposed year-round and seasonal road closures would have minimal impact on recreational users. In Alternative 3, the three year-round road closures, Burnette Gap (FDR 108), Duncan Ridge Branch (FDR 39B) and Mark Helton Branch (FDR 33B) and road decommissioning are dead-end roads with minimal vehicular use that would continue to provide walk-in access upon closure. The seasonal road closures only impact vehicular use from January through mid-March when recreational use is at a minimum. Increasing the existing parking areas would improve recreational access.

Cumulative Effects

In combination with other ongoing and proposed management activities, the proposed action (given that scenic mitigation measures would be utilized) would have minor to moderate cumulative effects on visual quality. Over the next ten years, relocation of unsustainable sections of the Duncan Ridge Trail may occur which could impact observer viewpoints but the specific re-routes are unknown at this point in time and therefore cannot be evaluated. Hemlock mortality due to the Hemlock Woolly Adelgid would continue over time leading to negative impacts to dispersed recreation and scenic quality.

3.17 Economic Analysis

An economic analysis of the alternatives was conducted to provide a reliable means to contrast the relative costs and benefits of the proposed activities. The results provide the Responsible Official with assurance that economic efficiency was considered. It also provides some information about the potential economic impacts of the alternatives. In order to quantify potential economic impacts, the net present value and Benefit/Cost ratio was determined for each alternative.

The net present value (NPV) is a formula used to determine the present value of an investment by the discounted sum of all cash flows received from the project. If we assume that income is received annually and the discount rate will be constant in the future, then NPV is expressed as the following formula:

$$NPV = I_0 + \frac{I_1}{1+r} + \frac{I_2}{(1+r)^2} + \ldots + \frac{I_n}{(1+r)^n}$$

Where; ***r*** = Annual discount rate;
n = Number of years from beginning to end;
I0 = Initial output dollar value expressed in year 2016 (expressed as a negative number)
In = Income per year/cycle

Benefit/Cost ratio is used to weigh the benefits of a project against its costs. The higher the ratio, the more favorable it would be to implement a particular project.

This analysis considered revenue derived from timber harvest activities and costs associated with planning, preparing and implementing timber harvest activities, road maintenance, and reconstruction. *Dollar amounts for costs and revenues are an estimate based on cost/price information in September, 2015.* Non-monetary benefits – associated with wildlife habitat and recreation, were not considered in this analysis. Moreover, neither were costs associated with prescribed burning. Results of the analysis are shown below in Table 3.17.1.

The following assumptions were made for this analysis:

- The analysis time-line begins with the environmental analysis process and continues through implementation of timber harvesting and stand improvement activities in stands identified under each of the action alternatives;
- Baseline costs and revenues for each activity are consistent across all alternatives for comparison purposes;
- No planning and analysis cost have been included in any of the alternatives;
- No prescribed burning cost were included in this analysis as prescribed burning is ongoing under previous decisions, timing of the prescribed burns to include the growing season is the only change proposed in this EA.
- Benefit values are based on current Forest transaction evidence appraisal data and cost values were derived from District service contract rates for similar projects; and
- Only action alternatives have monetary benefits (revenue from timber harvest).

Table 3.17.1 Results of economic analysis by Alternative for the Cooper Creek Project.

Alternative	PV-Costs	PV- Benefits	Net Present Value	Benefit/Cost Ratio
1 – No Action	$0.00	$0.00	$0.00	0
2 – Proposed Action	-$446,337	$310,752	-$135,585	- 0.70
3	-$275,828	$300,549	$24,711	1.09

Comparison of Alternatives

Alternatives 2 and 3 have higher present value (PV) benefits than Alternative 1 because these alternatives include returns from timber harvests. Present value costs are highest under Alternative 2 because of number of acres of timber stand improvement treatments, ie. midstory and release treatments. The number of acres within those treatments was reduced in Alternative 3. Even though the projected capital for Alternatives 2 returned a negative NPV, and Alternative 3 returned only a slight positive NTV, they may still be worth pursuing considering this EA documents the site-specific

analysis of implementing the Forest Plan within the Cooper Creek Project Area. The Cooper Creek Watershed Project is designed to support goals and objectives identified in Section 1.5 of this document (Forest Plan Direction).

Non-monetary benefits, such as wildlife habitat improvement and enhanced recreation opportunities, were not considered in calculations for this analysis. However, the qualitative and economic value of these actions would be realized in the addition of Resident and Non-resident visitor days. The result of these treatments and activities would likely have a multiplier effect on the local economy, thereby increasing the Benefit/Cost Ratio to a positive value. Additionally, activities associated with the action alternatives would provide jobs in the form of logging and other services – resulting in additional positive benefits on the local economy.

3.18 Heritage Resources

3.18.1 Affected Environment

Cultural resource sites represent the evidence for past human occupation of the region. Such sites include, but are not limited to, archeological sites (both prehistoric and historic), standing buildings, and other features on the landscape that reflect intentional human modification. Federal laws and Forest Service policy protect from disturbance those cultural resource sites determined to be scientifically or historically significant and considered eligible for inclusion on the National Register of Historic Places (NRHP). Sites that have been archeologically or historically researched and determined to be not eligible for the NRHP because they are not significant are not protected from disturbance under Federal law.

A series of surveys have been completed within the Cooper Creek watershed over the last 25 years to locate cultural resources. Previous surveys have located sites which represent the diversity of past human occupation of the area over the last twelve thousand years. They range from small American Indian camp sites used thousands of years ago to an early 20th century extinct community, and Civilian Conservation Corps construction. It is expected that there will be approximately 75 sites within the 1600 acres of potential ground disturbance in Alternative 3 after all surveys have been completed.

Sites Not Eligible for the NRHP are considered to be not significant and do not have to be protected. Eligible sites and sites with an undetermined status must be protected.

3.18.2 Effects of Heritage Resources

Measure

The measure of this effect is the number of sites found within the project area.

Bounds of Analysis (Temporal and Spatial)

The spatial analysis for the Cooper Creek project is within Compartments 398, 399, 503, 504, 505, 506, and 633 on the Blue Ridge Ranger District where activities are proposed. The time bound for this analysis would be approximately 10 years from implementation, whereas the cumulative effects would be indefinite until another project is proposed in or near the same area. Monitoring of protected sites would continue after project completion as part of the Forest's heritage resources management, and sites found during this survey would be on record for future projects in the area.

Alternative 1 – No Action

Direct Effects

Selecting the No Action Alternative would result in no project related activities occurring in the area at this time with the exception of ongoing dormant season prescribed burns. As a result, there would be no potential to disturb cultural resource sites. Selecting Alternative 1 would have no direct or indirect effects on heritage resources.

Alternative 2

Direct Effects

All the undertakings within the Proposed Action that have the potential to adversely affect cultural resources will be surveyed to locate cultural resources. Activities that disturb the ground surface have the potential to damage or destroy cultural resource sites. Actions such as commercial timber harvest, road reconstruction, temporary road construction, fire line construction, and any other activity utilizing heavy machinery has the potential to damage cultural resources. Archeological sites on the Chattahoochee-Oconee National Forest are typically fairly shallow. It is quite common for cultural deposits to be found no deeper than 30-40 cm, and at many prehistoric sites several thousand years of occupation may be present in a mere 30 cm of deposition. Historic period sites tend to be even shallower, with most deposits typically being no deeper than 10-20 cm. In addition, at historic sites there are often low surface features, such as rock foundations, that could be easily disturbed. As a result of sites being so shallow, archeological sites on the Forest can be severely impacted by activities that disturb the ground surface.

However, the Chattahoochee-Oconee National Forests have developed standard mitigations to protect cultural resources. These protective measures have been effective and sites recommended for protection from timber harvest have not been damaged. A buffer of 50 feet would be established and no ground disturbing activities would be permitted. If these mitigations are followed, there would be no direct effects to cultural resources as a result of ground disturbing activities associated with the Cooper Creek watershed project.

Alternative 3

Direct Effects

All the undertakings within Alternative 3 that have the potential to adversely affect cultural resources will be surveyed to locate cultural resources. Any sites recommended **Eligible** or **Undetermined** will be protected from ground disturbing activities. A buffer of 50 feet would be established and no ground disturbing activities would be permitted. As a result of the protective measures, Alternative 3 would have no effect on sites eligible for the NRHP.

All Alternatives - Indirect Effects

Indirect effects are those effects that may occur after the project has been completed, but which can be considered to be a result of project implementation. In the case of both ground-disturbing activities and prescribed fires, the most likely indirect effects to cultural resources include erosion of the cultural deposits and the increase of public accessibility to the sites. If the mitigation measures proposed elsewhere in this document are followed, there would be no erosion to cultural deposits. In regards to increased access to sites, the frequency of the vandalism and unauthorized excavation of archeological sites can be influenced by accessibility. However, it is anticipated that the accessibility of any sites likely to be vandalized would not be increased by this project. If all mitigation measures discussed in

this document are followed, there would be no indirect effects to cultural resource sites from ground disturbing activities or prescribed burns.

All Alternatives – Cumulative Effects

The laws and regulations pertaining to cultural resources are site specific in that the effects being considered are evaluated in regards to their effect on each particular cultural resource site. An adverse effect is considered to have occurred to a cultural resource site when the characteristics that may make that site eligible for inclusion on the National Register of Historic Places have been altered (36 CFR 800.5[a][b]). Therefore, cumulative effects to cultural resources are considered to be the incremental effects of past, present, and reasonable foreseeable future actions on each specific cultural resource site. In the case of the Cooper Creek project, these cumulative effects would consist of the combined outcome of the various potential direct and indirect effects discussed above, along with any effects from past and future activities in the project area. Past activities that have occurred in the area include burning, farming, and land clearing for agriculture, timber harvest, and road and trail construction. At the present time, the anticipated future use of the area consists primarily of continued timber harvesting, hunting-fishing, prescribed burning, and recreation. None of the alternatives considered would affect cultural resource sites. Therefore, there would be no cumulative effects to cultural resources as a result of the proposed project regardless of the alternative selected.

3.19 Public Health and Safety

3.19.1 Affected Environment

The project area is in a rural setting with a dispersed population. There are small communities scattered outside the project vicinity. Mulky Gap Road (FDR 4), Coopers Creek Road (FDR 33), Spenser Mountain Road (FDR 4D), Bryant Creek Road (FDR 33A) Duncan Ridge Road (FDR 39), Burnett Creek Road (FDR 261), Gillespie Branch Road (FDR 287), Owl Town Road and Highway 180 (Wolf Pen Gap Road) are located near the project area and will experience some use. The areas proposed for treatment in the project area currently do not pose any special threat to human health and safety. Major collector roads in the area have received the minimum maintenance to keep them passable, but are in need of additional surfacing to make them safer for log truck and passenger car traffic.

3.19.2 Effects on Public Health and Safety

Alternative 1 – No Action
Direct, Indirect and Cumulative Effects

Under the No-Action Alternative, conditions regarding public safety and health would remain status quo. Without any management activities, these stands would continue to experience natural mortality. Potential wildfires could threaten local landowners and forest users. Smoke from wildfires would cause hazardous driving conditions on local roads, increasing the probability of traffic accidents. The transportation system would continue to deteriorate, increasing the potential for accidents.

Prescribed burning activities would continue to be conducted throughout several units in the project area. Burning implementation and smoke from burning activities may hinder traffic by reducing visibility, but will be done in accordance within smoke management guidelines. Signs would be placed

in appropriate locations to warn drivers of any hazardous conditions. Smoke could also affect sensitive individuals and locations. Burning would be performed when harmful conditions would be minimized, utilizing smoke modeling programs and National Weather Service forecasts, in accordance with federal and state smoke management guidelines.

Alternative 2 – Proposed Action

Direct, Indirect and Cumulative Effects

Vegetation Management activities, specifically commercial timber sales, in the project area would increase the likelihood of travelers and local residents encountering heavy equipment and/or logging trucks on local roads. Gravel trucks or industrial logging trucks entering roads and highways could be hazardous to drivers. However, the presence of large vehicles, equipment and transport vehicles is not uncommon in the area. Signs placed at dangerous locations and intersections would warn motorists of any hazardous conditions.

Both foliar and cut-surface applications of the herbicide triclopyr are proposed under this Alternative. As reported in the Herbicide Risk Assessment (Appendix F) the typical Hazard Quotients HQs for the general public are all under 1.0 (indicating low risk) except for one scenario – non-accidental acute exposure of an adult female consuming treated vegetation. This scenario is highly unlikely because pesticide application areas are signed to preclude public exposure, foliar applications under this proposal would be targeted to treat stump sprouting vegetation which is unlikely to be consumed by human females, and with both foliar and cut surface applications, the amount of non-target vegetation subject to over-spray is very small.

Wildlife opening daylighting/early successional habitat creation would enhance recreation opportunities within the project area. These activities pose no threats to public health and safety.

Prescribed burning activities would continue to be conducted throughout several units in the project area. Burning implementation and smoke from burning activities may hinder traffic by reducing visibility, but will be done in accordance within smoke management guidelines. Signs would be placed in appropriate locations to warn drivers of any hazardous conditions. Smoke could also affect sensitive individuals and locations. Burning would be performed when harmful conditions would be minimized, utilizing smoke modeling programs and National Weather Service forecasts, in accordance with federal and state smoke management guidelines.

Alternative 3 –Direct, Indirect and Cumulative Effects

Effects from the implementation of this alternative on health and public safety would be similar to those discussed in Alternative 2. Monitoring of all activities would be done through supervision, on-site inspections, project reports, herbicide use reports, and post-project evaluations. It is unlikely that there would be any additional cumulative effects as a result of this alternative.

3.20 Transportation

3.20.1 Affected Environment

The existing road system on National Forest lands within the Cooper Creek Project Area, which consists of the Cooper Creek and Coosa Creek and Youngcane Creek watershed's, was largely constructed over the last 50 years to develop areas for timber harvesting and for other purposes such as

fire protection. However in recent decades there has been a steadily increasing growth in the amount and type of recreation use such as hiking, camping, hunting, fishing wildlife viewing and pleasure driving. The project area has a transportation system already in place which allows access to timber stands and prescribed burn units along with access for recreational uses. These roads are mostly all-weather roads used by the public for land access and recreational opportunities as well as agency personnel for resource management activities. The transportation network is complimented by roads under county and state jurisdiction that provide access to the Forest Development Roads. Examples of such County and State roads include Mulky Gap Road (County Rd 163) and Cooper Creek Road (County Rd 228).

National Forest System roads were planned, designed and engineered to be maintained to standards that would insure their sustainability and provide for user safety. Many of the roads within the project area do not meet current standards for safety or environmental protection; in addition current funding levels are not adequate to maintain existing roads to the standards originally planned, standards which allows for minimal ecological impacts, and allow for efficient and safe use. Given the inadequate funding levels, the agency has been challenged to find ways to better manage the road system with limited resources. The Chattahoochee - Oconee National Forest has made a forest-wide effort to identify a future transportation system through the Transportation Analysis Planning Process (TAPS). The TAPS allows the agency to balance scientific information, public needs, safety and environmental protection, and funding levels when determining the size, purpose, and extent of the future Forest Transportation System and any specific road reconstruction or construction activities.
Forest System Roads are classified into road maintenance levels (ML 1-5), as follows:

- ML 1 – Roads are closed to vehicular traffic and receive custodial maintenance only, primarily for resource protection.
- ML 2 – Roads are maintained to provide for passage of high-clearance vehicles. Roads receive minimum maintenance.
- ML 3 – Roads are maintained for travel by the prudent driver in a standard passenger vehicle. The comfort and convenience of the user is a low priority.
- ML 4 – Roads provide a moderate degree of driver comfort and convenience.
- ML 5 – Roads are maintained for a high degree of driver comfort and convenience. Road surfacing is usually asphalt.

Each maintenance level of road is further classified by access restrictions.

The following table illustrates the Maintenance Levels of all the roads within the project area and the current status of their access.

Table 3.20.1 Maintenance Level and public access status for forest roads within the Cooper Creek project area.

Road Number	Road Name	BMP	EMP	Maintenance Level	Access*
107	West Wolf Creek	0.0	3.0	3	Open Year Round
108	Burnett Gap	0.0	2.4	2	Open Seasonally
		2.4	3.0	1	Closed
236	Cavender Gap	0.0	2.92	3	Open Year Round
261	Burnett Creek	0.0	3.12	2	Open Seasonally
264	Sea Creek	0.0	4.00	2	Open Year Round
264-A	Knight Creek	0.0	2.90	2	Open Year Round
264-B	Longcove Creek	0.0	1.15	2	Open Year Round
298	Bowers Cove	0.0	1.0	2	Open Seasonally

		1.0	2.12	1	Closed
287	Gillespie Branch	0.0	2.00		Open Year Round
33	Cooper Creek	0.0	10.50	3	Open Year Round
33-A	Bryant Creek	0.0	3.27	3	Open Year Round
33-B	Mark Helton Branch	0.0	4.50	2	Open Seasonally
37	Lake Winfield Scott	0.0	1.16	5	Open Seasonally (Campground Access)
37-C	Lake Winfield Scott Branch C	0.0	0.10	2	Campground Access
37-D	Lake Winfield Scott Branch D	0.0	0.15	2	Campground Access
39	Duncan Ridge	0.0	10.0	2	Open Year Round
39-B	Duncan Ridge Branch	0.0	2.20	2	Open Seasonally
395	Fortenberry	0.0	2.10	2	Open Year Round
4	Mulky Gap	0.0	7.57	3	Open Year Round
4-B	Clements Branch	0.0	1.71	2	Open Seasonally
		1.71	3.0	1	Closed
4-C	Fish Knob	0.0	2.74	2	Open Seasonally
		2.74	3.23	2	Closed
4-D	Spencer Mountain	0.0	3.37	2	Open Seasonally
637	Flatlands	0.0	1.50	2	Open Year Round
774	Ride-A-Horse	0.0	1.20	2	Seasonal
88	Dixon Branch	0.0	3.70	2	Open Year Round

***Open:** Open to public vehicle use

***Admin. Only:** Access only for resource management personnel. No public vehicle use

***Seasonal:** Seasonal public vehicle use

***Closed:** Road in storage and closed year-round

Within the Cooper Creek Project Area the Forest Transportation System currently contains approximately 27.5 miles of ML 3 Roads, 53.0 miles of ML 2 Roads, and 3.5 miles of ML 1 (closed) roads. Much of this transportation system does not meet Forest Service design standards and would not sustain continued motorized use at current levels. Poor drainage, encroaching vegetation, and lack of adequate surface material have created conditions that limit vehicle access for public and administrative uses and have contributed to sediment loads through erosion. Efforts to minimize negative impacts due the above mentioned conditions at current budget levels, often are short lived and/or fall short of providing proper compensation for today's public use levels and types. Conversely many of the roads within the project area are not adequate to accommodate timber haul with tractor-trailer (long-haul) configurations. They are characterized by curves with tight radii, short culverts, and limited turnouts. In addition to existing condition of the above mentioned roads, some roads were pioneered by early settlers; others were planned for temporary access but access was never eliminated or limited. Still others evolved from tracks made by off-road vehicles. Due to their haphazard nature, such roads usually have more adverse impacts on the environment than do permanent, properly planned forest roads which are well engineered and maintained. There are several miles of illegal all-terrain vehicle (ATV) routes branching off the existing transportation system, as well as several trash dumping sites along the sides of existing roads.

3.20.2 Effects to Transportation

Alternative 1 – No Action

Direct and Indirect Effects

The existing condition of the roads in the project area would persist. Minimal routine road maintenance such as surface blading, roadway mowing, and spot surfacing may be performed, but with only these activities, roads proposed for reconstruction and reconditioning would continue to degrade and erosion rates would not be reduced. Roads proposed for new access management standards would remain open, to today's vehicular traffic levels and road density would not be decreased. However, any adverse impacts to the roads associated with timber harvest would be avoided but, conversely, no road improvement would be made as a result of any timber harvesting. Likewise the road conditions would continue to worsen to an eventual point of catastrophic failure and/or extensive resource damage in locations that would then require construction/reconstruction or closure depending upon agency determined need. Management in this area would essentially be as needs dictated, and on a reactionary basis.

Cumulative Effects

The condition of transportation infrastructure would continue to worsen and pose a chronic threat to water quality. Problem erosion areas would continue to persist and improvements to these areas would be on a reactionary basis after resource damage has occurred. These effects, combined with road-related erosion issues on adjacent private lands, would continue to degrade water quality within the watershed.

Alternative 2 Proposed Action

This proposed action includes road reconstruction to improve access by commercial timber haul configurations, to repair and or replace infrastructure and to improve drainage, erosion, and sediment loss for the project area. Due to the decision to limit certain long haul configuration access to timber sale units; roads would not require extensive curve widening and turnouts to accommodate logging haul trucks and equipment, but would still need some minor alignment adjustments, along with improvements to the drainage systems (ditching, culverts and drainage dips – roadway reconditioning) and surfacing to meet Georgia Best Management Practices and Forest Plan Direction. (See table in Chapter 2; page 15.) The road improvements will occur through the proposed actions, including upgrading drainage systems (ditching, culverts and water bars, drain crossings, etc.), improving road alignment and traffic flow (curve widening and turnouts) resurfacing the roadbed, and repairing eroded areas. Initially, the proposed road management activities would have potential to cause an increase in sediment over current levels; however these increases would be temporary. Because these actions would ultimately reduce the potential for erosion, the overall long term effects would be beneficial. The reconstructed roads would allow safe access for commercial haul configurations into timber sale units and would more closely align infrastructure with Georgia's Best Management Practices and Forest Plan direction. This would reduce the potential for the development of safety hazards and negative impacts to area resources from erosion.

Roads expose and compact soils, and alter surface water flow. If left open to constant vehicular traffic, they would continue to contribute to higher erosion rates than closed roads with proper water controls and surface cover. Road closures range from many different types of traffic barriers, (gates, guardrails, earthen berms etc.), to complete obliteration and decommissioning. The proposed changes to access management, seasonal closures (22 miles) and permanent closures (6.7 miles) to public access would reduce the impacts from vehicular traffic, thus reducing the impact on these roads from erosion, and reducing overall maintenance needs and costs.

Cumulative Effects

Historically periodic road maintenance within this transportation system occurred as often as a bi-annually, with most all maintenance occurring on an annual rotation at a minimum. However, with recent budget and resource constraints this historical maintenance regime has not been sustained. Due to the reduced frequency of maintenance cycles, the maintenance and repair needs of this system have become more extensive and likewise the cost of system repairs have become higher and higher. The proposed reconstruction activities would improve road surfaces for the future, reversing many effects of an inadequate maintenance regime, returning these roads back to a standard which would allow for a more routine maintenance cycle with reduced future costs. After the initial reconstruction activities the impacts of disturbance would also be reduced, by reducing erosion problems and improving traffic control. Increasing the mileage of seasonally closed roads will also have future benefits by eliminating negative impacts resulting from vehicular use during these sensitive time periods which will ultimately remove future costs burdens and ground disturbances needed to repair the damage that has historically occurred from use during unfavorable weather seasons.

Alternative 3

Direct and Indirect Effects

In general, effects from implementation of this alternative would be similar to those discussed for Alternative 2. The extent of road reconstruction associated with timber harvest access will be reduced due to the removal of Spencer Mountain Road from the harvest plan. However the amount of reconstruction associated with improving BMP's and generally increasing the standard of the existing transportation system will be slightly increased (see table in chapter 2; page 23). Roads would not require extensive curve widening and turnouts to accommodate logging haul trucks and equipment, but would still need improvements to the drainage systems (ditching, culverts and drainage dips – roadway reconditioning) and surfacing to meet Georgia Best Management Practices and Forest Plan Direction. The initial impacts of the implemented road reconstruction and reconditioning could temporarily increase erosion and sedimentation transportation, but with the improvements made the overall effects would be beneficial. This alternative also proposes the implementation of some of the Chattahoochee Forest's TAP recommendations – see table 3.20.2.

Cumulative Effects

Cumulative effects of this alternative would be similar to those described for Alternative 2.
Table 3.20.2 illustrates the proposed changes to the transportation system for all alternatives and references the Transportation Analysis Report (TAR), and resource management recommendations from the Chattahoochee-Oconee Transportation Analysis Plan (TAP). The TAR is based on the Transportation System Analysis which is a Forest-wide effort to identify a future transportation program. It identifies roads that need a change in management and recommends future use of system roads. It is a reference document, not a decision, to be used as a tool for decisions about future management.

Table 3.20.2 Proposed changes to project area forest roads based on TAP.

Road Number	Road Name	BMP	EMP	Maintenance Level	Alternative1: No Action	Alternative 2: Proposed Action	Alternative 3: Modified Proposed Action	TAP Recommended Actions
107	West Wolf		3.0	2	No Action	No Action	No Action	No Change.

	Creek				Open Access ML 2			Continue with current management.
108	Burnett Gap		3.0	1	No Action Seasonal Access ML 1	No Action	Implement TAP Recommendation Lower the first 2.4 miles to a ML1 – prohibit all motor vehicle use. Decommission the last 0.60 miles.	Lower the first 2.4 miles to a ML1 – prohibit all motor vehicle use. Decommission the last 0.60 miles.
236	Cavender Gap		2.92	3	No Action Open Access ML 3	No Action	No Action	No change. Continue with current management.
261	Burnett Creek		3.10	2	No Action Seasonal Access ML 2	Reconstruction to accommodate commercial timber haul and improve road drainage. Seasonal Access Remain ML 2	Reconstruction to accommodate commercial timber haul and improve road drainage. Seasonal Access Remain ML 2	No change. Continue with current management.
264	Sea Creek		4.0	2	No Action Open Access ML 2	Seasonal Access Remain ML 2	Seasonal Access Remain ML 2	Seasonal Access ML 2
264A	Knight Creek		2.9	2	No Action Open Access ML 2	Seasonal Access Remain ML 2	Seasonal Access Remain ML 2	Administrative access only ML 2
264B	Longcove Creek		1.15	2	No Action Open Access ML 2	Seasonal Access Remain ML 2	Seasonal Access Remain ML 2	Administrative access only ML 2
287	Gillespie Branch		2.0	2	No Action Open Access ML 2	Reconstruction to accommodate commercial timber haul and improve road drainage. Seasonal Access Remain ML 2	Reconstruction for commercial timber haul and improve road drainage. Seasonal Access Remain ML 2	Remain ML 2 Seasonal Access
298	Bowers Cove		2.12	2	No Action Seasonal Access ML 2	No Action	No Action	Remain ML 2 Seasonal Access
33	Cooper Creek		10.5	3	No Action Open Access ML 3	Reconstruction to accommodate commercial timber haul and improve road drainage. Open Access ML 3	Reconstruction to accommodate commercial timber haul and improve road drainage. Open Access ML 3	No change. Continue with current management.
33A	Bryant Creek		3.27	3	No Action Open Access ML 3	Reconstruction to accommodate commercial timber haul and improve road drainage. Seasonal Access Remain ML 3	Reconstruction for commercial timber haul and improve road drainage. Seasonal Access Remain ML 3	No change. Continue with current management.
33B	Mark Helton		4.5	2	No Action	Lower to ML 1	Lower to ML 1	Lower to ML 1

	Branch				Seasonal Access ML 2	Prohibit all motor vehicle use	Prohibit all motor vehicle use	Prohibit all motor vehicle use
37	Lake Winfield Scott		1.16	5	No Action	No Action	No Action	Continue with current management
37C	Lake Winfield Scott Br. C		0.10	2	No Action	Implement TAP Recommendation Raise to a ML 4	Implement TAP Recommendation Raise to a ML 4	Raise to ML 4
37D	Lake Winfield Scott Br. D		0.20	2	No Action	Implement TAP Recommendation Raise to a ML	Implement TAP Recommendation Raise to a ML	Raise to a ML 3
39	Duncan Ridge		10	2	No Action Open Access ML 2	Reconstruction to accommodate commercial timber haul and improve road drainage. Implement TAP. Raise to ML 3 on Segment from FDR 4 to junction with FDR 33A. Seasonal Access on Segment from FDR 4 to junction with FDR 33A	Reconstruction to accommodate commercial timber haul and improve road drainage. Implement TAP. Raise to ML 3 on Segment from FDR 4 to junction with FDR 33A. Seasonal Access on Segment from FDR 4 to junction with FDR 33A	Raise to ML 3 on Segment from FDR 4 to junction with FDR 33A. Seasonal Access (portion of road)
39B	Duncan Ridge Branch		2.2	2	No Action Seasonal Access ML 2	Implement TAP. ML2 Prohibit public motor vehicle use. Administrative access only	Implement TAP. ML2 Prohibit public motor vehicle use. Administrative access only	ML2 Prohibit public motor vehicle use. Administrative access only
395	Fortenberry		2.1	2	No Action Open Access ML 2	No Action	Implement TAP Recommendation Decommission	Decommission
4	Mulky Gap		7.57	3	No Action Open Access ML 3	Reconstruction to accommodate commercial timber haul and improve road drainage Open Access Remain ML 3	Reconstruction for commercial timber haul and improve road drainage Open Access Remain ML 3	Continue with current management.
4B	Clements Branch		3	2	No Action Seasonal Access Ml 2	No Action	No Action	No change. Continue with current management.
4C	Fish Knob		2.7	2	No Action Seasonal Access ML 2	No Action	No Action	No change Continue with current management.
4D	Spencer Mountain		3.30	2	No Action Seasonal Access ML 2	Reconstruction to accommodate commercial timber haul and improve road drainage Seasonal Access Remain ML 2	Reconstruction not needed to accommodate timber harvest and access.	No change. Continue with current management.
637	Flat Lands		1.5	2	No Action Open Access	Implement TAP Recommendation	Implement TAP Recommendation	Seasonal Access ML 2

					ML 2	Seasonal Access ML 2	Seasonal Access ML 2	
774	Ride-A-Horse		1.2	2	No Action Seasonal Access ML 2	No Action	No Action	No change.
88	Dixon Branch		3.7	2	No Action Open Access ML 2	Implement TAP Recommendation Seasonal Access ML 2	Implement TAP Recommendation Seasonal Access ML 2	Seasonal Access ML 2

3.21 Irreversible or Irretrievable Commitment of Resources

There would be no irretrievable commitment of resources as a result of the Cooper Creek action alternatives, as there are no areas proposed for construction of new roads.

3.22 Consistency with Laws

None of the alternatives threatens a violation of Federal, State, or local laws or requirements imposed for the protection of the environment. As documented in this EA or in the project file, alternatives would be consistent with the following applicable laws and Executive Orders:

- American Indian Religious Freedom Act of 1978 Antiquities Act of 1906 (16 USC 431433)
- Archaeological and Historical Conservation Act of 1974 (16 USC 469)
- Archaeological Resources Protection Act of 1979 (16 USC 470) Cave Resource Protection Act of 1988
- Clean Air Act of 1977 (as amended) Clean Water Act of 1977 (as amended)
- Endangered Species Act (ESA) of 1973 (as amended)
- Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended) Historic Sites Act of 1935 (16 USC 461467)
- Multiple Use Sustained Yield Act of 1960
- National Environmental Policy Act of 1969, (as amended) (42 USC 43214347)
- National Forest Management Act (NFMA) of 1976 (as amended)
- National Historic Preservation Act of 1966 (16 USC 470)
- Organic Act 1897
- Prime Farmland Protection Act
- Wild and Scenic Rivers Act of 1968, amended 1986
- Forest Service Manuals such as 2361, 2520, 2670, 2620, 2760 Executive Order 11593 (cultural resources)
- Executive Order 11988 (floodplains) Executive Order 11990 (wetlands)
- Executive Order 12898 (environmental justice)
- Executive Order 12962 (aquatic systems and recreational fisheries) Executive Order 13112 (NNIS)

3.23 Summary of Unavoidable Adverse Effects

Despite diligent use of mitigation measures, some adverse effects cannot be avoided. Adverse effects to air quality, the landscape, and wildlife habitat would be unavoidable under any of the action alternatives. Air quality would be affected by timber hauling and increased recreation traffic on untreated roads (dust). Timber harvesting may also cause soil loss and sedimentation in nearby streams. Sedimentation could cause loss of habitat for freshwater aquatic species.

Wildfires would also adversely affect the air quality due to the high smoke production of young, dense stands. The operation of combustion engines would also cause adverse effects. Thinning timber and reconditioning roads in highly visible areas would affect the landscape (FEIS, pages 3-646 and 3-647). Under the No-Action Alternative, no timber harvesting or timber stand improvements would occur. The vigor of the stands proposed for thinning would continue to decline. They would become progressively more susceptible to bark beetles and other diseases. Some plant and animal species may suffer adverse effects due to the loss of appropriate early seral habitat. Smoke from wildfires would temporarily affect air quality.

3.24 Summary of Short-term and Long-term Productivity

The Chattahoochee-Oconee National Forest is managed to protect long-term productivity of the land. Most management activities and resource outputs are short-term uses (FEIS, page 3-647). The mitigation measures required for each action alternative reduce or eliminate adverse effects on long-term productivity by protecting resources. Monitoring requirements (Forest Plan, pages 5-1 through 5-7) ensure that short-term uses do not impair the long-term productivity of the land.

CHAPTER 4: REFERENCES CITED

Anders, A.D.; Faaborg, F.; Thompson, R. 1998. Postfledging dispersal, habitat use, and home- ranges size of juvenile wood thrushes. Auk 115, 349-358.

Batcher, M. 2000. Element stewardship abstract: *Ligustrum* spp, [online]. In: Management library: Control methods—plants. In: global Invasive Species Team (GIST). Arlington, VA: The Nature Conservancy (Producer). Available: http://www.invasvie.org/gist/esadocs/documnts/ligu_su.pdf.

Bernazzani, P., Bradley, B., and Opperman, J. (2012). Integrating climate change into habitat conservation plans under the U.S. Endangered Species Act. Environmental Management, 49(6), 1103-1114. (TACCIMO)

Birdsey, Richard; Pregitzer, Kurt; and Lucier, Alan. 2006. Forest carbon management in the United States: 1600-2100. Journal of Environmental Quality 35, 1461-1469.

Bosch, J.M. and J.D. Hewlett 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. Journal of Hydrology. 55:3-23.

Brantley, Steven, Chelcy R. Ford, James M. Vose. 2013. Future Species Composition Will Affect Forest Water Use After Loss of Eastern Hemlock from Southern Appalachian Forests. Ecological Society of America. Ecological Applications, 23(4), 2013. pp 777-790.

Britzke, E. R., M. J. Harvey, and S. C. Loeb. 2003. Indiana bat, *Myotis sodalis*, maternity roosts in the Southern United States. Southeastern Naturalist 2(2):235-242.

Broadwell, R. 1992. Draft Element Stewardship Abstract for Speyeria diana.Unpubl. Rept. 6pp.

Brooks, K.N., P.F. Ffolliott, H.M. Gregersen and L.F. DeBano. 1997. Hydrology and the management of watersheds. 2nd Edition. Iowa State University Press. Ames, Iowa. Pgs 361 -364.

Burroughs, E.R., Jr and J.G. King. 1989. Reduction of soil erosion on forest roads. Res. Pap. Int-GTR-264. USDA Forest Service. Intermountain Research Station. 21p.

Callaham, Jr., Mac A., D. Andrew Scott, Joseph J. O'Brien, John A. Stanturf. 2012 Cumulative Effects of Fuel Management on the Soils of Eastern U.S. Watersheds. In: Cumulative Watershed Effects of Fuel Management in the Eastern United States. GTR SRS-16. USDA Forest Service
Camp, C.D., J.B. Jensen and M. Elliot, 2004. Salamanders of the Chattahoochee and Oconee National Forests. 2004.

Campbell J. W., J. L. Hanula, and T. A. Waldrop. 2007. Observations of *Speyeria diana* (Diana Fritillary) utilizing forested areas in North Carolina that have been mechanically thinned and burned. Southeastern Naturalist 6(1): 179-182.

Chafin, L. 2007. Species profiles for Appalachian Twayblade, *Listera smallii*. Georgia Department of Natural Resources. Available online at www.georgiawildlife.com/conservation.

Chafin, L. 2008. Species profiles for Dwarf Ginseng, *Panax trifolius*. Georgia Department of Natural Resources. Available online at www.georgiawildlife.com/conservation

Chiang, Jyh-Min; McEwan, Ryan W.; Yaussy, Daniel A.; and Brown, Kim J. 2008. The effects of prescribed fire and silvicultural thinning on the aboveground carbon stocks and net primary production of overstory trees in an oak-hickory ecosystem in southern Ohio. Forest Ecology and Management 255, 1584-1594.

Choctawhatchee, Pea and Yellow Rivers Watershed Management Authority. 2000. A Guideline for Maintenance and Service of Unpaved Roads. Choctawhatchee, Pea and Yellow Rivers Watershed Management Authority. 2000. 69pp.

Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.

Clinton, B.D., and J.M. Vose. 2000. Plant succession and community restoration following felling and burning in the southern Appalachian Mountains. Pages 22-29 in W. Keith Moser and Cynthia E Moser (eds.). Fire and forest ecology: innovative silviculture and vegetation management. Tall Timbers Fire Ecology Conference Proceedings, No. 21. Tall Timbers Research Station, Tallahassee, FL.

Clinton, Barton D., James M. Vose. 2007. Fuels consumption and nitrogen loss following prescribed fire: a comparison of prescription types in the Southern Appalachians. e-Gen. Tech. Rep. SRS–101. U.S. Department of Agriculture, Forest Service, Southern Research Station: 231-240 [CD-ROM].

Clinton, Barton D. 2010. Stream Water Responses to Timber Harvest: Riparian Buffer Width Effectiveness. Forest Ecology and Management 261 (2011) 979-988.

Clinton, Barton D., James M. Vose, Erika C. Cohen. 2012. Geographic Considerations for Fire Management in the Eastern United States: Geomorphology and Topography, Soils, and Climate. In: Cumulative Watershed Effects of Fuel Management in the Eastern United States. GTR SRS-16. USDA Forest Service.

Cox, J. A., and B.Widener. 2008. Lightning-season burning: friend or foe of breeding birds? Miscellaneous Publication 17. Tall Timbers Research Station, Tallahassee, FL.
Source URL: http://www.clemson.edu/extension/pfc/pfc_docs/fire_breeding_birds.pdf

Crawford, H. S., R. G. Hooper, and R. W. Tittterington. 1981. Songbird population response to silvicultural practices in central Appalachian hardwoods. J. Wildl. Manage. 45:680-692.

D'Amato, Anthony W.; Bradford, John B.; Fraver, Shawn; and Palik, Brian J. 2011. Forest management for mitigation and adaptation to climate change: insights from long-term silvicultural experiments. Forest Ecology and Management 262, 803-816.

Degraaf, R. M., V. E. Scott, R. H. Hamre, L. Ernst, and S. H. Anderson. 1991. Forest and Rangeland Birds of the United States. Natural History and Habitat Use. USDA Forest Service. Agricultural Handbook 688. 625pp.

Dickson, J.G., ed. 2001. Wildlife of southern forests: habitats and management. Blaine, WA: Hancock House Publishing. 472 p.

Donovan, T., P. Jones, E. Annand, and F. Thompson. 1997. Variation in local scale edge effects: mechanisms and landscape context. Ecology 78(7), 2064-2075.

DuGuay, J., P. Wood, and J. Nichols. 2001. Songbird abundance and avian nest survival rates in forests fragmented by different silvicultural techniques. Cons. Biol.15 (5), 1405-1415.

Edwards, Pamela J., Charles A. Troendle. 2012 Effects of Fire and Fuels Management on Water Quality in Eastern North America. In: Cumulative Watershed Effects of Fuel Management in the Eastern United States. GTR SRS-16. USDA Forest Service.

Edwards, L., J. Ambrose, and L.K. Kirkman. 2013. The Natural Communities of Georgia. Athens, GA: University of Georgia Press. 675 pp.

Evans, C.W., D.J. Moorhead, C.T. Bargeron,and G.K. Douce. 2006. Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton, GA, BW-2006-03. 52 p.

Erickson, Heather E.; White, Rachel. 2008. Soils under fire: soils research and the Joint Fire Science Program. Gen. Tech. Rep. PNW-GTR-759. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 17 p.

Elliott, Katherine J.; Vose, James M.; Clinton, Barton D. 2002. Growth of eastern white pine (*Pinus strobus* L.) related to forest floor consumption by prescribed fire in the Southern Appalachians. Southern Journal of Applied Forestry. 26 (1): 18-25

Elliott, Katherine J. and Vose, James M. 2005. Initial Effects of Prescribed Fire on Quality of Soil Solution and Streamwater in the Southern Appalachian Mountains. Southern Journal of Applied Forestry 29(1), 5-15.

Elwood, Jerry W., Michael J. Sale, Philip R. Kaufmann, Glenn F. Cada. 1991. The Southern Blue Ridge Province. In: Acidic Deposition and Aquatic Ecosystems. Regional Case Studies. Edited by Donald F. Charles. Sprinter-Verlag New York Inc.

Evans, A. M. & Perschel, R. (2009). A review of forestry mitigation and adaptation strategies in the Northeast U.S. Climatic Change, 96(1). (TACCIMO).

Federal Register. 2015. Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule; Final Rule and Interim Rule. 50 CFR Part 17.

Ford W.M., J.L Rodrigue, E.L Rowan, S.B. Castleberry and T.M. Schuler. 2010. Woodland salamander response to two prescribed fires in the central Appalachians in Forest Ecology and Management 260 (2010) 1003-1009.)

Freeman, B.J. 1993. Protected Species Survey for the Proposed Blairsville Airport: Fishes. GA DNR (2005); Part 1: Standard Operating Procedures for Conducting Biomonitoring on Fish Communities in Waderable Streams in Georgia, GA DNR, WRD, Fisheries Management Section. 2005.

Froehlich, Henry A. (1973). The impact of even-age forest management on physical properties of soils. In 'Even-age Management'. (Eds. R. K. Hermann and D. P. Lavender.) pp. 190-220. School of Forestry, Oregon State Univ., Corvallis.

Fuller, T.K.; DeStefano, S. 2003. Relative importance of early-successional forests and shrubland habitats to mammals in the northeastern United States. Forest Ecology and Management. 185: 75-79.

Ganapathy, Carissa. 1997. Environmental Fate of Triclopyr. Environmental Monitoring and Pest Management Branch, Department of Pesticide Regulation. Sacramento, CA.

Georgia Department of Natural Resources, 1999. Protect Animals of Georgia. Georgia Department of Natural Resources, Wildlife Resources Division, Non-Game Wildlife-Natural Heritage Section. 247pp.

Georgia Department of Natural Resources. 2009. Trout Streams of Georgia. August, 2009.

Georgia Department of Natural Resources. 2011. Coosa North Georgia Regional Water Plan.

Georgia Department of Natural Resources - Environmental Protection Division, Atlanta, GA.
Georgia Department of Natural Resources. 2013. Georgia's Plan for the Adoption of Water Quality Standards for Nutrients (Revision 2.0). Georgia Department of Natural Resources - Environmental Protection Division, Atlanta, GA.

Georgia Department of Natural Resources. 2015. Water Use and Water Quality Standards: Chapter 391-3-6 (2015). Georgia Department of Natural Resources - Environmental Protection Division, Atlanta, GA.

Georgia Forestry Commission. 2013. Forestry Pesticide Applications – Complying with Georgia's Pesticide General Permit (GAG820000). Georgia Forestry Commission, Macon, GA 4 pp.

Georgia Forestry Commission. 2009. Georgia's Best Management Practices for Forestry. Georgia Forestry Commission, Macon, GA 72 pp.

Greenberg, C. H. 2000. Individual variation in acorn production by five species of Southern Appalachian oaks. Forest Ecology and Management, 132:199-210.

Greenberg, C.H.; Waldrop, T.A.; Tomcho, J. [and others]. 2013. Bird response to fire severity and repeated burning in upland hardwood forest. Forest Ecology and Management. 304: 80-88.

Greenberg, C.H.; Loeb, S. 2014. What are the effects of fire on nongame species in the southern Appalachians? In: Rankin, W.T.; Herbert, N., eds. Restoration in the southern Appalachians: a dialogue among scientists, planners, and land managers. Gen. Tech. Rep. SRS-189. Asheville, NC: US Department of Agriculture Forest Service, Southern Research Station. 48 p.

Gregory, S.V., K.L. Boyer, and A.M. Gurnell, editors. 2003. The ecology and management of wood in rivers. American Fisheries Society, Symposium 37, Bethesda, Maryland.

Greacen EL, Sands R (1980) Compaction of forest soils. A review. Australian Journal of Soil Research **18** , 163–189. http://dx.doi.org/10.1071/SR9800163

Hamel, P. B. 1992. Land Manager's Guide to Birds of the South. The Nature Conservancy, Southeastern region, Chapel Hill, NC 437pp.

Hardy, Colin C.; Ottmar, Roger, D; Peterson, Janice L., Core, John E., and Seamon, Paula. 2001. Smoke Management Guide for Prescribed and Wildland Fire. National Wildfire Coordination Group. 226 p. http://www.nwcg.gov/pms/pubs/SMG/SMG-72.pdf

Harris, L. Jr. 1972. Diana. Speyeria diana Cramer. Pages 276-278 In: Butterflies of Georgia. University of Oklahoma Press. Norman, OK. 326pp.

Harvey, Michael J. 1992. Bats of the Eastern United States. Arkansas Game and Fish Commission in cooperation with USFWS and Tennessee Tech. U., Cookeville, TN. 46 pp.

Hatchell, G. E., C.W. Ralston, and R.R. Foil. 1970. Soil Disturbances in Logging: Effects on Soil Characteristics and Growth of Loblolly Pine in the Atlantic Coastal Plain. Journal of Forestry, Volume 68, Number 12, 1 December 1970, pp. 772-775(4).

Haupt, Harold F. and W. Joe Kidd. 1965. Good logging practices reduce sedimentation in central Idaho. J. Forestry Vol.63, No. 9: 63:664-670.

Howard, R. F., M. J. Singer, and G. A. Frantz. 1981. Effects of soil properties, water content, and compactive effort on the compaction of selected California forest and range soils. Soil Sci.Soc. Am. J. 45:231-236.

Hunter, Chuck; Katz, Robert; Pashley, David; Ford, Bob. 1999. Partners in Flight Bird Conservation Plan for the Southern Blue Ridge (physiographic area 23). American Bird Conservancy. 78 p.

Jensen, J.B., C.D. Camp, W. Gibbons, and M. Elliot, 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, GA. 2009.

Joyce, Linda A.; Blate, Geoffrey M.; McNulty, Steven G.; Millar, Constance I.; Moser, Susanne; Neilson, Ronald P.; and Peterson, David L. 2009. Managing for multiple resources under climate change: National Forest. Environmental Management 44, 1022-1032.

Keefer, L. 2003. East Fork Coosa Creek Population Sample Data Sheet. Georgia DNR 2003.

Knapp, Eric. E., Becky L. Estes, Carl N. Skinner. 2009. Ecological Effects of Prescribed Fire Season: A Literature Review and Synthesis for Managers. PSW-GTR-224. USDA Forest Service. 85pp.

Klaus, N.A., S.A. Rush, T.S. Keyes, J. Petrick, and R.J. Cooper. 2010. Short-term effects of fire on breeding birds in southern Appalachian upland forests. The Wilson Journal of Ornithology 122(3): 518-531.

Kolka, R.K. 2012 Water Yield and Hydrology. In: Cumulative Watershed Effects of Fuel Management in the Eastern United States. GTR SRS-16. USDA Forest Service.

Kolka, R.K. 2012. Effects of Fire and Fuels Management on Water Quality in Eastern North America in Cumulative Watershed Effects of Fuel Management in the Eastern United States. USDA Forest Service SRS-GTR-161.

Knoepp, Jennifer D.; DeBano, Leonard F.; Neary, Daniel G. 2005. Chapter 3: Soil Chemistry. In: Neary, Daniel G.; Ryan, Kevin C.; DeBano, Leonard F., eds. Wildland fire in ecosystems: effects of fire on soils and water. Gen. Tech. Rep. RMRS-GTR-42-vol.4. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 53-71.

Keyser, T.; Malone, J.; Cotton, C.; and Lewis, J. 2014. Outlook for Appalachian-Cumberland forests: a subregional report from the Southern Forest Futures Project. Gen. Tech. Rep. SRS-188. Asheville, NC: U.S. Department of Agriculture Forest Service, southern Research Station. 83 pp.

Laerm, J. 1981. Plecotus rafinesquii (Rafinesque's Big-Eared Bat). In: A survey of the status, distribution, and abundance of potentially threatened and endangered vertebrates in Georgia. Part IV: The Mammals. Final Report to the Georgia Department of Natural Resources. 161pp. Unpubl.

Laerm, J. 1995. Star-nosed mole. Unpubl. Manuscript. 6pp.

Lakel III, William A., Wallace M. Aust, M. Chad Bolding, C. Andrew Dolloff, Patrick Keyser, Robert Feldt. Sediment Trapping by Streamside Management Zones of Various Widths after Forest Harvest and Site Preparation. 2010. Society of American Foresters. Forest Science 56 (6) 2010. 11 pp.

Lancia, R. A., J. A. Gerwin, M. S. Mitchell, W. M. Baughman, T. B. Wigley. 2000. Avian diversity and productivity on an intensively managed, industrial forest in South Carolina: The Westvaco Example. In: Fragmentation 2000 conference, Sept. 17-20,2000. Annapolis, MD.

Laseter, Stephanie H., Chelcy R. Ford, James M. Vose and Lloyd W. Swift Jr. 2012. Long-term temperature and precipitation trends at the Coweeta Hydrologic Laboratory, Otto, North Carolina, USA. Hydrology Research 43(6):890-901.

La Sorte, F. A., F. R. Thompson III, M. K. Trani, T. J. Mersman. 2007. Population trends and habitat occurrences of forest birds on southern national forests, 1992-2004. Gen. Tech. Rep. NRS-9. Newtown Square, PA. USDA Forest Service, Northern Research Station. 260p.

Liechty, Hal O.; Luckow, Kenneth R.; and Guldin, James M. 2005. Soil chemistry and nutrient regimes following 17-21 years of shortleaf pine-blue stem restoration in the Ouachita mountains of Arkansas. Forest ecology and Management 204, 345-357.

Loeb, Susan C. 2001. Inventory of the bats of the Chattahoochee National Forest. Final Report. Southern Research Station, Clemson University.

Marshall, M.R., J.A. DeCecco, A.B. Williams, G.A. Gale, and R.J. Cooper. 2003. Use of regenerating clearcuts by late-successional bird species and their young during the post-fledging period. Forest Ecology and Management 183: 127-135.

Martof, B. S., W. M. Palmer, J. R. Bailey, and J. R. Harrison. 1980. Amphibians and Reptiles of the Carolinas and Virginia. Univ. of NC Press. Chapel Hill. 264pp.

MacNeil, J.E. and R.N. Williams. 2014. Effects of Timber Harvests and Silvicultural Edges on Terrestrial Salamanders. PLoS ONE 2014; 9(12): e114683.

McDonald, H.N. 2001. The Impact of Logging on Aquatic Salamander Communities. Electronic Theses and Dissertations. Paper 37. http//dc.etsu.edu/etd/37.

McDonnell, T.C., M.R. Sloat, T.J. Sullivan, C.A. Dolloff, P.F. Hessburg, N.A. Povak, W.A. Jackson and C. Sams. 2015. Downstream Warming and Headwater Acidity May Diminish Coldwater Habitat in Southern Appalachian Mountain Streams. PLoS ONE 2015; 10(8): e0134757.

McNab, W. H., Stephens, R. B.; Mavity, E. M.; Baggs, J. E.; Wentworth, J. M.; Rightmyer, R. D.; Jaume, A. J.; Jackson, B. D.; Joyce, M. P. 2015. Development of an ecological classification system for the Cooper Creek watershed of the Chattahoochee National Forest: a first approximation. In Proceedings of the 17th biennial southern silvicultural research conference. e–Gen. Tech. Rep. SRS–203. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 10 p.

McDermott, M.E.; Wood, P.B. 2011. Post-breeding bird responses to canopy tree retention, stand size, and edge in regenerating Appalachian hardwood stands. Forest Ecology and Management. 262: 547-554.

Menzel, M. A., T. C. Carter, and S. L. Pierce. 1998. A Survey of Macro- and Micro-Habitat Characteristics Influencing the Use of Mines in Smithgall Woods and Fort Mountain State Parks in the Blue Ridge Province of Georgia as Hibernacula by Bats. A technical report submitted to the Georgia Department of Natural Resources Non-Game Endangered Wildlife Program.

Meyer, Judy L.; Jones, Krista L.; Poole, Geoffrey C.; Jackson, C. Rhett; Kundell, James E.; Rivenbark, B. Lane; Kramer, Elizabeth L.; Bumback, William. 2005. Implications of changes in riparian buffer protection for Georgia's trout streams. Report funded by Georgia EPD. University of Georgia, Athens. 78 pp.

Moorman, C.E.; Russell, K.R.; Greenberg, C.H. 2011. Reptile and amphibian response to hardwood forest management and early successional habitats. In: Greenberg, C.H.; Collins, B.; Thompson, F.R.,

III, eds. Sustaining Young Forest Communities: Ecology and Management of Early Successional Habitats in the Central Hardwood Region, USA. Managing Forest Ecosystems, 2011, Vol. 21: 191-208.

Mount, R. H. 1975. The Reptiles and Amphibians of Alabama. Auburn University Agricultural Experiment Station. 347pp.

Napper, C., Howes, S.W., Page-Dumroese, D. 2009. Soil Disturbance Field Guide. San Dimas, CA: USDA Forest Service, San Dimas Technology Development Center. 112p. (0819 1815P)

NatureServe. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1 NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

Neary, Daniel G.; Ryan, Kevin C.; DeBano, Leonard F., eds. 2005. Wildland fire in ecosystems: effects of fire on soils and water. Gen. Tech. Rep. RMRS-GTR-42-vol.4. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 250 pp.

Norris, L.A., Lorz, H.W., and Gregory, S.V. 1991. Forest Chemicals. American Fisheries Society Special Publication 19:207-296.

Nuzzo, V. 1997. Element Stewardship Abstract for Lonicera japonica, Japanese honeysuckle. The Nature Conservancy, Arlington, VA. 22 pp.

Odum, E.P. 1969. The strategy of ecosystem development. Science. 164: 262-270.

Odum, E.P.; Barrett, G.W. 2005. Fundamentals of Ecology. 5th ed. Belmont, CA: Thomson, Brooks/Cole Publishing. 598 p.

O'Keefe, J.M. 2009. Roosting and foraging ecology of forest bats in the Southern Appalachian Mountains. PhD Dissertation. Clemson University, Clemson, SC.

Opler, P. A. 1992. Diana Speyeria diana. Page 150 In : A field guide to eastern butterflies. Houghton Mifflin Company, New York.

Osborne, Kevin; Dicus, Christopher; Isbell, Clint; Ager, Alan; and Landram, Michael. 2010. Effects of landscape-level fuel treatments on carbon sequestration on carbon emissions and storage over a 50 year time cycle. In: Wade, D.D. and Robinson, M.L. (eds.). Proceedings of 3rd Fire Behavior and Fuels Conference, October 25-29, 2010, Spokane, Washington. International Association of Wildland Fire, Birmingham, AL, pp 1-5.

Ozier, J. C. 1999. Rafinesque's Big-eared Bat. Pages 11-12 In: Protected Animals of Georgia. Georgia Dept. of Natural. Resources.

Page-Dumroese, D.S., Abbott, A.M., Rice, T.M. 2009. Forest Soil Disturbance Monitoring Protocol, Volume 1: Rapid Assessment. FS-WO-82a. Moscow, ID: USDA Forest Service, Rocky Mountain Research Station. 29p.

Phillips, M.J., Swift, L.W. Jr., and Blinn, C.R. (2000). Best Management Practices for Riparian Areas. In Verry, E.S., Hornbeck, J.W., and Dolloff, C.A. (eds.) Riparian Management of Forests of the Continental Eastern United States (pp273-286). New York: Lewis Publishers.

Raison, R. J., H. Keith, and P. K. Khanna. Effects of fire on the nutrient-supplying capacity of forest soils. FRI bulletin-Forest Research Institute, New Zealand Forest Service (1990).

Rankin, W.T.; Herbert, N., eds. 2014. Restoration in the southern Appalachians: a dialogue among scientists, planners, and land managers. Gen. Tech. Rep. SRS-189. Asheville, NC: US Department of Agriculture Forest Service, Southern Research Station. 48 p.

Reeves, D., M.G. Reeves, A.M. Abbott, D.S. Page-Dumroese, and M.D. Coleman. 2011. A detrimental soil disturbance prediction model for ground-based timber harvesting. Can. J. For. Res. 42:821-830 (2012)

Reeves, Derrick; Page-Dumroese, Deborah; Coleman, Mark. 2011. Detrimental soil disturbance associated with timber harvest systems on National Forests in the Northern Region. Res. Pap. RMRS-RP-89. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 12 p.

Reilly, Matthew J., Thomas A. Waldrop, Joseph J. O'Brien. 2012. Fuels Management in the Southern Appalachian Mountains, Hot Continental Division. In: Cumulative Watershed Effects of Fuel Management in the Eastern United States. GTR SRS-16. USDA Forest Service.

Reinhart, Kenneth G. 1964. Effect of a Commercial Clearcutting in West Virginia on Overland Flow and Storm Runoff. J. For. Vol. 62, (3) March 1964. pp. 167-171(5)

Renken, R.B. 2005. Does Fire Affect Amphibians and Reptiles in Eastern U.S. Oak Forests? In Fire in Eastern Oak Forests: Delivering Science to Land Managers. Proceedings of a Conference edited by Dickinson, M.B. GTR-NRS-P-1)

Reynolds, K.M., P.F. Hessburg, T. Sullivan, N. Povak, T. McDonnell, B. Cosby, and W. Jackson. 2012. Spatial Decision Support for Assessing Impacts of Atmospheric Sulfur Deposition on Aquatic Ecosystems in the Southern Appalachian Region. In *2012 45th Hawaii International Conference on System Science (HICSS)*, 1197–1206. doi:10.1109/HICSS.2012.542.

Rightmyer, R.D., and Stephens, R.B. 1996. Landtype Associations of the Chattahoochee National Forest, Georgia. Gainesville, GA: U.S. Department of Agriculture, Forest Service. Unpublished report.

Robichaud, Pete R.; MacDonald, Lee H.; Foltz, Randy B. 2010. Fuel management and erosion. In: Elliot, William J.; Miller, Ina Sue; Audin, Lisa, eds. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 79-100.

Robinson, S., F. Thompson, T. Donovan, D. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. Science 267, 31.

Rush, S.A. and B.J.M. Stutchbury. 2008. Survival of fledgling Hooded Warblers (*Wilsonia citrina*) in small and large forest fragments. Auk 125: 183-191.

Rush, S., N. Klaus, T. Keyes, J. Petrick, and R. Cooper. 2012. Fire severity has mixed benefits to breeding bird species in the southern Appalachians. *Forest Ecology and Management* 263:94-100.

Ryan, Michael G.; Harmon, Mark E.; Birdsey, Richard A.; Giardina, Christian P. (and others). 2010. A synthesis of the science on forests and carbon for U.S. forests. Ecological Society of America: Issues in Ecology, 13: 1-16.

Sandberg, David V.; Hardy, Colin C.; Ottmar, Roger D.; Snell, J.A. Kendall; Acheson, Ann; Peterson, Janice L.; Seamon, Paula; Lahm, Peter; Wade, Dale. 1999. National strategic plan: Modeling and data systems for wildland fire and air quality. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 60 p.

Sauer, J. R.; J. E. Hines; J. E. Fallon; K. L. Pardieck; D. J. Ziolkowski, Jr.; and W. A. Link. 2014. The North American Breeding Bird Survey, Results and Analysis 1966 - 2012. Version 02.19.2014 USGS Patuxent Wildlife Research Center, Laurel, MD.

Sawyers, B.C., M.C. Bolding, W.M. Aust and W.A. Lakel III. 2012. Effectiveness and implementation costs of overland skid trail closure techniques in the Virginia Piedmont. Journal of Soil and Water Conservation. July/August 2012, vol. 67, no. 4:300-310.

Scott, J. A. 1986. Speyeria diana Great Smokkies Fritillary. Page 324 In:
The Butterflies of North America. A Natural History and Field Guide. Stanford University Press. Stanford, CA. 583pp.

Scheff, Robert James, "The Development Of Old-Growth Structural Characteristics In Second-Growth Forests Of The Cumberland Plateau, Kentucky, U.s.a." (2012). *Online Theses and Dissertations.* Paper 116. http://encompass.eku.edu/etd/116

Shelton, A. 2011. Predicting Invasive Species Spread.
http://www.indiana.edu/~preserve/InvasiveSpread/home.html.

Silvis, Alexander, W. Mark Ford, Eric R. Britzke, Joshua B. Johnson. 2014. Association, roost use and simulated destruction of Myotis septentrionalis maternity colonies. Behavioral processes 103 (2014): 283-290.

Silvis, Alexander, W. Mark Ford, and Eric R. Britzke. 2015. Effects of hierarchical roost removal on northern long-eared bat (Myotis septentrionalis) maternity colonies. PLoS ONE 10 (1): e0116356.

Stednick, J.D. 1996. Monitoring the effects of timber water yield harvest on annual water yield. Journal of Hydrology 176 (1996) 79-95.

Stevens, S. 2002. Element stewardship abstract: Lespedeza cuneata (Dumont-Cours.) G. Don— sericea lespedeza, Chinese bush clover, [online]. In: Management library: Control methods— plants. In: global Invasive Species Team (GIST). Arlington, VA: The Nature Conservancy (Producer). Available: http://www.invasvie.org/gist/esadocs/documnts/lespcun.pdf.

Strahler, A.N., 1957. Quantitative Analysis of Watershed Geomorphology. Transaction American Geophysical Union. Vol. 38 No. 6 pp. 913 -920.

Starbuck, C.A., S.K. Amelon, F. R. Thompson, III. 2014. Relationships between bat occupancy and habitat and landscape structure along a savanna, woodland, forest gradient in the Missouri Ozarks. Wildlife Society Bulletin 39(1):20-30.

Sullivan, Timothy J., Bernard J. Cosby, and William A. Jackson. 2011. Target Loads of Atmospheric Sulfur Deposition for the Protection and Recovery of Acid-Sensitive Streams in the Southern Blue Ridge Province. *Journal of Environmental Management* 92, no. 11: 2953–60. doi:10.1016/j.jenvman.2011.07.014.

Swank, W. T., DeBano, L. F., & Nelson, D. 1989. Effects of timber management practices on soil and water. Burns, Russell [Tech. comp.]. The scientific basis for silvicultural and management decisions in the National Forest System. GTR-WO-55. Washington, DC. USDA Forest Service, pg. 79-106.

Swank, W. T., J. M. Vose, K. J. Elliott. 2001. Long-term hydrologic and water quality responses following commercial clearcutting of mixed hardwoods on a southern Appalachian catchment. Forest Ecology and Management 143 (2001) 163-178.

Sun, G., Riedel, M., Jackson, R., Kolka, R., Devendra, A. & Shepard, J. (2004). Influences of Management of Southern Forests on Water Quantity and Quality. USDA Forest Service General Technical Report SRS-75. USDA Forest Service, Southern Research Station, Asheville, NC.

TACCIMO (Template for Assessing Climate Change Impacts and management Options). Accessed Nov. 14, 2014.

Tomlinson, George H. 1990. Effects of Acid Deposition on the Forests of Europe and North America. Boca Raton, Fl: CRC Press. 296 p.

Tu, M., C. Hurd, R. Robison, and J.M. Randall. 2001. Weed control methods handbook. The Nature Conservancy. Source URL: http://www.invasive.org/gist/products/handbook/triclopyr.pdf

United States Environmental Protection Agency. 2012. DRAFT inventory of U.S. greenhouse gas emissions and sinks: 1990-2010. United States Environmental Protection Agency, Washington DC, 470 pp.

USDA Forest Service. 2008. Guidelines and techniques to achieve scenic integrity objectives and landscape character in Southern Region National Forests. April 2008.

USDA Forest Service. 1994. Ecological Subregions of the United States: Section Descriptions. WO-WSA-5. W.H. McNab and P.E. Avers, compilers. Washington, D.C. U.S. Department of Agriculture, Forest Service. 200pp.

USDA Forest Service. 1997. Guidance for conserving and restoring old-growth forest communities on National Forests in the Southern Region. Report of the Region 8 Old- Growth team. Forestry Report R8-FR 62. Southern Region, Atlanta, GA. 118 pp plus appendices.

USDA Forest Service. 2003a. FSH 2509.18 - Chapter 2 – Soil Quality Monitoring. Soil Management Handbook. Atlanta, GA. U.S. Department of Agriculture, Forest Service, Southern Region.

USDA Forest Service. 2003b. Management Indicator Species Population and Habitat Trends. Chattahoochee-Oconee National Forests. 91pp.

USDA Forest Service. 2004a. Final Environmental Impact Statement for the Land And Resource Management Plan Revision. Chattahoochee-Oconee National Forests. Management Bulletin R8-MB 113 B. USDA Forest Service, Southern Region, Atlanta, GA.

USDA Forest Service. 2004b. Chattahoochee-Oconee National Forests Land and Resource Management Plan. R8-MB 113 A. USDA Forest Service, Southern Region, Atlanta, GA.

USDA Forest Service 2004c. Compilation of Breeding Bird Survey Data for Management Indicator Species (MIS) on the Chattahoochee-Oconee National Forests 1992-2003.

USDA Forest Service. 2006. Management Indicator Species Population Trend Report, Chattahoochee-Oconee National Forests. September 2006.

USDA Forest Service 2009. Environmental Assessment. Non-Native Invasive Species Treatment, Blue Ridge and Conasauga Ranger Districts. USDA Forest Service, Chattahoochee-Oconee National Forests. 54pp.

USDA Forest Service. 2011. Watershed Condition Classification Technical Guide. FS-978. J.P. Potyondy and T.W. Geier, primary authors. Washington, D.C. U.S. Department of Agriculture, Forest Service. 41pp.

USDA Forest Service. 2012. Forest Plan Monitoring and Evaluation Report, Chattahoochee- Oconee National Forests. Fiscal Year 2012.

USDA Natural Resources Conservation Service. 1996. Soil Survey of Fannin and Union Counties, Georgia. Athens, GA. U.S. Department of Agriculture.

USDA, National Resource Conservation Service – National Center of Excellence. 2010. Annual Precipitation by State.

USDA Natural Resources Conservation Service. 2015. Web Soil Survey on-line soil survey.

U. S. Fish and Wildlife Service. 1992. Small Whorled Pogonia (Isotria medeoloides) Recovery Plan, First Revision. Newton Corner, MA. 75 pages.

U. S. Fish and Wildlife Service. 2007. Indiana bat (*Myotis sodalis*) draft recovery plan: first revision. U.S. Fish and Wildlife Service, Region 3, Fort Snelling, MN. 258pp.

U. S. Fish and Wildlife Service. 2009. Indiana Bat (Myotis sodalis) 5-year review: Summary and Evaluation. USFWS Midwestern Region 3, Bloomington, IN.

U. S. Fish and Wildlife Service. 2014. NLEB interim conference and planning guidance. Regions 2-6.

U. S. Fish and Wildlife Service. 2015. Biological opinion. Activities affecting the northern long-eared bat on Southern Region National Forests. FWS Log #04E00000-2015-F-003.

Vanderberg, M. R., Boston, K., Bailey, J. (2011). Maximizing carbon storage in the Appalachians: A method for considering the risk of disturbance events (General Technical Report NRS-P-78). In: Fei, S.,Lhotka, J.M., Stringer, J.W., Gottschalk, K.W., Miller, G.W., eds. Proceedings, 17th central hardwood forest conference, 2010 April 5-7, Lexington, KY. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 134-142.

Vega Rivera, J.H., J.H. Rappole, W.J. McShea, and C.A. Hass. 1999. Postbreeding movements and habitat use of adult Wood Thrushes in northern Virginia. Auk 116: 458-466.

Waters, T.F. 1995. Sediment in streams: sources, biological effects, and control. American Fisheries Society Monograph 7.

Weakley, A. S. 2007. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas. University of North Carolina, Chapel Hill, NC. 1015pp. Available: http://www.herbarium.unc.edu/flora.htm

Webb, Rick. 2004. Effects of Acidic Deposition on Aquatic Resources in the Central Appalachian Mountains. A Shenandoah Watershed Study Report. Department of Environmental Sciences, University of Virginia. 88pp.

Webster, W. D., J. F. Parnell, and W. C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. Univ. of North Carolina Press, Chapel Hill and London.

Webster, J.R., K. Morkeski, C.A. Wojculewski, B.R. Niederlehner, E.F. Benfield, and K.J. Elliott. 2012. Effects of Hemlock Mortality on Streams in the Southern Appalachian Mountains. The American Midland Naturalist (2012) 168:112-131.

Wilson, L. A. 1995. Land Manager's Guide to the Amphibians and Reptiles of the South. The Nature Conservancy, Southeastern Region. Chapel Hill, NC. 360pp.

CHAPTER 5: CONSULTATION AND COORDINATION

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